Comtech EF Data is an
AS9100 Rev B / ISO9001:2000 Registered Company

Vipersat

CDD-56X Series

Satellite Network Demodulator Router
User Guide

CDD-562L
CDD-564/564L

MN/22137 Revision 1

Vipersat CDD-56X Series

CDD-562L, CDD-564/564L

Satellite Network Demodulator Router

User Guide

Part number MN/22137
Document Revision 1

Firmware Version 1.6.11/2.6.11

April 21, 2013

COMTECH EF DATA

VIPERSAT Network Products Group
3215 Skyway Court
Fremont, CA 94539
USA

Phone: (510) 252-1462
Fax: (510) 252-1695
www.comtechefdata.com

Part Number: MN/22137
Revision: 1

Firmware Version: 1.6.11/2.6.11

©2013 by Comtech EF Data, Inc. All rights reserved. No part of this manual may be copied or reproduced without prior written permission of Comtech EF Data, Inc.

IMPORTANT NOTE: The information contained in this document supersedes all previously published information regarding this product. Product specifications are subject to change without prior notice.

Comtech reserves the right to revise this publication at any time without obligation to provide notification of such revision. Comtech periodically revises and improves its products and, therefore, the information in this document is subject to change without prior notice. Comtech makes no warranty of any kind with regard to this material, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. No responsibility for any errors or omissions that may pertain to the material herein is assumed. Comtech makes no commitment to update nor to keep current the information contained in this document.

Patents and Trademarks
All products, names and services are trademarks or registered trademarks of their respective companies. See all of Comtech EF Data's patents and patents pending at http://patents.comtechefdata.com.

Printed in the United States of America

Document Revision History

Revision	Date	Description
0	3/10/08	**Initial Release** *Note*: This new document part number, MN/22137, supersedes the previous CDD-56X User Guide part number, 22137. **New functionality in v1.5.4**: New DPC enhancements; STDMA Power Hunt; Hitless Switching; New VMS registration and Managing Address method; UDP Port Base Address selection; Auto Home State Failsafe; SOTM.
1	4/21/13	Update content to reflect NP v1.6.11/2.6.11. **New Features**: Dynamic Entry Channel Mode (ECMv2).

{ *This Page is Intentionally Blank* }

Table of Contents

Chapter 1
General

How to Use This Manual 1-1
Manual Organization 1-1
Chapter 1 — General 1-1
Chapter 2 — Quick Start Configuration 1-1
Chapter 3 — Using the Command Line Interface (CLI) 1-2
Appendix A — Network Addressing . . 1-2
Appendix B — Automatic Switching . . 1-2
Appendix C — Dynamic Power Control 1-2
Appendix D — ECM Migration 1-2
Appendix E — Glossary 1-2
Conventions and References 1-2
Product Description 1-4
Introduction 1-4
Demodulator Features 1-4
Router Features 1-4
Network and Bandwidth Management . . 1-5
Dynamic SCPC (dSCPC) 1-5
STDMA 1-6
Single Hop On Demand 1-6
Turbo Product Coding 1-6
Header Decompression 1-6
Payload Decompression 1-7
Data Decryption 1-7
New in This Release 1-7
1.6.11/2.6.11 Release 1-7
Dynamic Entry Channel Mode 1-7
Customer Support 1-8
Contact Information 1-8
Return Material Authorization 1-8
Reader Comments / Corrections 1-8

Chapter 2
Quick Start Configuration

Introduction 2-1
Initial Configuration 2-2
Terminal Connection 2-2
Network Role 2-2
Setting Vipersat CDD-56X Operating Parameters 2-3
Set the Feature Configuration 2-3
Set the IP Address 2-6
Configure the Route Table 2-7
Routing in a Vipersat Network 2-7
Creating the Routes 2-8
Set the Satellite Demod Configuration . 2-9
Set the Vipersat Configuration 2-10

Chapter 3
Using the Command Line Interface (CLI)

General 3-1
Common Screen Commands 3-2
Demod Select 3-2
Save Parameters to Permanent Storage 3-2
Exit 3-2
Telnet Logout 3-2
Menu Descriptions 3-3
Main Menu 3-3
Administration 3-3
Feature Configuration 3-5
Vipersat Feature Codes 3-5
Vipersat Management 3-6
Vipersat STDMA 3-6
Vipersat Auto Switching 3-6
Vipersat File Streamer 3-7
Vipersat Configuration 3-8
STDMA Mode 3-8
STDMA 3-9
STDMA Tx Rate 3-10
Hub Type 3-10
1 – Fixed 3-11
2 – Dynamic Slot 3-11
3 – Dynamic Cycle 3-11
4 – GIR 3-11
5 – Entry Channel 3-12
6 – ECMv2 3-12
ECMv2 Mode 3-13
Group ID 3-14
STDMA Max Power Hunt 3-14
Low Data Rate Fast Acquisition 3-15
Burstmap Multicast IP 3-15
Outbound IP 3-16
Cycles Per Burst Map 3-16

Slot Guardband 3-17
Slot Preamble Length 3-18
Slot Data Length 3-18
Nominal Data Length 3-19
Maximum Data Length 3-19
Minimum Data Length 3-20
Total Slot Count 3-20
Slot Cycle Length 3-21
Slot Start in Cycle 3-21
Set Remotes 3-21
Adding a Remote to the STDMA Group . 3-22
Base 3-23
Remote Count 3-23
Set Remote Policies 3-24
Delete Remote 3-26
Enable/Disable Remote 3-27
View Remote(s) 3-27
Remove Timeout 3-28
Remove Retry Timeout 3-28
LNB LO Frequency 3-29
Satellite Frequency Conversion 3-29
STDMA Statistics 3-30
Stats Accumulation Window 3-30
Clear 3-31
Show Hub Statistics 3-31
STDMA/SCPC Automatic Switching 3-32
Auto Switching 3-33
Current WAN Transmit Mode 3-34
Load Switching 3-34
STDMA Slot Capacity 3-34
STDMA Switch Delay 3-35
Percent Allocation 3-35
Keep Alive Timer for Carrier Inhibit . . 3-36
Hitless Switching Parameters 3-36
Delay for Mod 3-37
Delay for Demod 3-37
LockTimes 3-37
Apply Delay Values 3-38
SOTM Update 3-38
Unit Role 3-38
Expansion Unit 3-39
Network ID 3-39
Unit Name 3-40
Receive Multicast Address 3-40
Managing IP Address 3-41
Management Security 3-42
Primary Heart Beat 3-44
Home State Revert 3-44
Dynamic Power Control Configuration . . 3-44
DPC Enabled 3-46
Speed Up EbNo 3-46
Target DPC Address 3-46
Set Home State Parameters 3-47
Set Current Configuration as Home State . . 3-48
Force Modem to Home State 3-48
STDMA State 3-49
Receive Frequency 3-49
Receive Data Rate 3-49
Receive FEC Type 3-50
Receive Coding Rate 3-50
Receive Modulation Type 3-51
Vipersat Summary 3-51
Vipersat Migration 3-52
UDP Port Base Address 3-53
Alerts 3-53

Appendix A
Network Addressing

Introduction A-1
The OSI Reference Model A-2
Layers 1 – 3 . . . . . A-2
Binary Math A-4
IP Addressing A-6
IP Address Classes A-6
Class A A-6
Class B A-6
Class C A-7
Class D A-7
Class E A-8
Private Network IP Addresses A-8
Network Address Translation (NAT) . . . A-8
Subnets A-8
Subnet Mask A-9
Network Segments A-10
Default Gateways A-11
MAC Addresses A-11

Appendix B
Automatic Switching

General B-1
Hitless Switching B-2
Load Switching B-4
Overview B-4

Bandwidth Allocation and Load Switching by the Hub STDMA Burst Controller . . . B-5
Load Switching—STDMA Hub B-8
Hub Switching Parameters B-8
Hub Switching Process B-9
Load Switching—Remote B-10
Remote Switching Parameters B-10
Determination for Switching B-12
Load Switch Example B-13
Reduced Data Flow in Switched Mode (SCPC) B-14
Application Switching B-16
ToS Switching B-18
ToS Background B-18
Detection of ToS Stamped Packets . . B-19
Configuration B-20
Example Implementations B-21
ToS Switching Per Device B-21
ToS Switching Per Traffic Type B-21
ToS Remarking B-22
ToS to DSCP Value Conversions . . . B-23
Mesh Setup Based on ToS Detection . B-24
Entry Channel Mode Switching B-25
STDMA Entry Channel Mode B-25
Fail-Safe Operation B-26
Using STDMA ECM B-28
Switching an ECM Remote from SCPC to STDMA B-29
Dynamic Entry Channel Mode B-31
Hub Configuration B-32
Remote Configuration B-33
ECM Processing B-34

Appendix C
Dynamic Power Control

Introduction C-1
Description C-3
BER Waterfall Mapping C-3
Delta Power Compensation C-3
Theory of Operation C-4
Configuration C-7
Main DPC Menu C-9
Enable DPC C-10
Target Eb/No C-10
Speed Up Eb/No Range C-11
Target DPC (IP) Address C-11
Calculate Max Power Menu C-11
Calibrated Data Rate C-13
DPC Margin C-13
Nominal Power Level C-13
Max Data Rate C-13
Max Code Rate C-13
Max Modulation C-13
Max FEC Type C-13
Calculate Max Power C-13
Max Power C-14
Signal Power Level Considerations C-15
Power Considerations C-16
Cabling Considerations C-16

Appendix D
ECM Migration

General D-1
Migration Procedure D-3
Configure Remote Units D-3
Configure Hub Unit D-5

Appendix E
Glossary

. . . . . E-1

{ *This Page is Intentionally Blank* }

List of Figures

Chapter 2 Figures

Figure 2-1 Main Menu screen. 2-4
Figure 2-2 Administration screen 2-4
Figure 2-3 Feature Configuration screen 2-5
Figure 2-4 FAST Feature Code dialog 2-5
Figure 2-5 Working Mode dialog 2-6
Figure 2-6 Ethernet Interface screen 2-7
Figure 2-7 Configuring the Route Table screen 2-9
Figure 2-8 Rx Configuration screen 2-10
Figure 2-9 Vipersat Configuration screen (Hub). . 2-10

Chapter 3 Figures

Figure 3-1 Main Menu screen. 3-3
Figure 3-2 Administration screen 3-4
Figure 3-3 Working Mode dialog 3-4
Figure 3-4 Feature Configuration screen 3-5
Figure 3-5 FAST Feature Code dialog 3-6
Figure 3-6 Vipersat Configuration screen (Hub)3-8
Figure 3-7 STDMA screen (Hub, STDMA, Fixed type). 3-9
Figure 3-8 STDMA screen (Hub/Remote, SCPC) 3-9
Figure 3-9 Hub Type prompt 3-10
Figure 3-10 ECMv2 Mode prompt 3-13
Figure 3-11 Group ID prompt 3-14
Figure 3-12 STDMA Max Power Hunt prompt 3-15
Figure 3-13 Burstmap Multicast IP prompt. . . 3-16
Figure 3-14 Outbound IP prompt 3-16
Figure 3-15 Cycles per Burst Map prompt . . . 3-17
Figure 3-16 Slot Guardband prompt. 3-17
Figure 3-17 Slot Preamble Length prompt . . . 3-18
Figure 3-18 Slot Data Length prompt 3-19
Figure 3-19 Nominal Data Length prompt . . . 3-19
Figure 3-20 Maximum Data Length prompt . . 3-20
Figure 3-21 Minimum Data Length prompt. . . 3-20
Figure 3-22 Total Slot Count prompt 3-21
Figure 3-23 STDMA Remotes Menu screen . 3-22
Figure 3-24 Remote Name and IP Address prompt 3-22
Figure 3-25 Base Remote Display prompt . . . 3-23
Figure 3-26 STDMA Remote Policies screen (GIR Hub) 3-24
Figure 3-27 GIR Remote Policies prompt. . . . 3-25
Figure 3-28 Entry Channel Switch Rates screen . 3-25
Figure 3-29 Remote SCPC Data Rate prompt 3-26
Figure 3-30 Global SCPC Data Rate prompt . 3-26
Figure 3-31 Global Switch Type prompt 3-26
Figure 3-32 Delete Remote prompt 3-27
Figure 3-33 Enable/Disable Remote prompt . 3-27
Figure 3-34 View Remote(s) screen 3-27
Figure 3-35 Remove Timeout prompt. 3-28
Figure 3-36 Remove Retry Timeout prompt . . 3-28
Figure 3-37 LNB LO Frequency prompt 3-29
Figure 3-38 Satellite Frequency Conversion prompt 3-29
Figure 3-39 STDMA Statistics screen (Hub). . 3-30
Figure 3-40 STDMA Statistics screen (Remote). . 3-30
Figure 3-41 Stats Accumulation Window prompt . 3-31
Figure 3-42 Show Hub Statistics screen. 3-31
Figure 3-43 Automatic Switching screen 3-33
Figure 3-44 STDMA Slot Capacity prompt . . . 3-34
Figure 3-45 STDMA Switch Delay prompt . . . 3-35
Figure 3-46 Percent Allocation prompt 3-35
Figure 3-47 Keep Alive Timer for Carrier Inhibit prompt 3-36
Figure 3-48 Hitless Switching screen 3-37
Figure 3-49 Set LockTime prompt 3-38
Figure 3-50 Unit Role prompt 3-38
Figure 3-51 Expansion Unit prompt 3-39
Figure 3-52 Network ID prompt 3-40
Figure 3-53 Unit Name prompt 3-40
Figure 3-54 Receive Multicast IP Address prompt 3-41
Figure 3-55 Managing IP Address prompt . . . 3-41
Figure 3-56 Vipersat Management Security screen 3-43
Figure 3-57 Encryption Key Entry prompt. . . . 3-43
Figure 3-58 DPC Configuration screen (Hub, STDMA) 3-45
Figure 3-59 DPC Configuration screen (Hub/ Remote, SCPC) 3-45
Figure 3-60 Speed Up EbNo prompt 3-46
Figure 3-61 Target DPC Address prompt 3-47

Figure 3-62 Home State Configuration screen3-48
Figure 3-63 Force Modem to Home State warning 3-49
Figure 3-64 Receive Frequency prompt 3-49
Figure 3-65 Receive Data Rate prompt 3-50
Figure 3-66 Receive FEC Type prompt 3-50
Figure 3-67 Receive Coding Rate prompt . . . 3-50
Figure 3-68 Receive Modulation Type prompt 3-51
Figure 3-69 Vipersat Summary screen. 3-51
Figure 3-70 Vipersat Migration prompt. 3-53
Figure 3-71 UDP Port Base Address prompt . 3-53

Appendix A Figures

Figure A-1 The Seven OSI Protocol Layers . . .A-2
Figure A-2 Bits and Bytes. A-4
Figure A-3 Binary to Decimal Conversion A-4
Figure A-4 IP Address Classes A, B, C A-7
Figure A-5 NAT Router Example A-8
Figure A-6 Default Subnet Masks for IP Classes . A-9
Figure A-7 ANDing an IP address and a subnet mask A-10
Figure A-8 Network Segments A-10
Figure A-9 Router as Default Gateway. A-11
Figure A-10 Network Node MAC Addresses .A-12

Appendix B Figures

Figure B-1 Hitless Switching screen. B-2
Figure B-2 Auto Switching Menu, CDM-570/570L Hub B-8
Figure B-3 Hub Load Switching Page, SLM-5650A B-8
Figure B-4 Auto Switching Menu, CDM-570/570L Remote B-11
Figure B-5 Remote Load Switching Page, SLM-5650A B-11
Figure B-6 Load Switching diagram B-13
Figure B-7 Application Switching diagram . . .B-16
Figure B-8 ToS Field Location within the IP Header B-18
Figure B-9 Remote ToS Switching menu B-20
Figure B-10 Per Device ToS Switching Example . B-21
Figure B-11 Per Type ToS Switching Example . . B-22
Figure B-12 ToS Remarking Application . . . B-23
Figure B-13 ToS and DSCP Conversion Chart . . B-23
Figure B-14 ECM Switch Recovery: < 3 minutes . B-27
Figure B-15 ECM Switch Recovery: > 3 minutes . B-28
Figure B-16 STDMA Page with Entry Channel Mode, CDM-570/570L B-29
Figure B-17 ECM Remote List Page, CDM-570/570L B-30
Figure B-18 Remote Bandwidth Entry, CDM-570/570L B-30
Figure B-19 Revert Uplink Carrier Command, VMS modem B-31
Figure B-20 Entry Channel Mode v2 Configuration, Hub (CDD-564L) B-33
Figure B-21 Entry Channel Mode v2 Configuration, Remote (CDM-570L) B-34
Figure B-22 ECMv2 Processing Diagram. . . B-35

Appendix C Figures

Figure C-1 Data Rate to Power Relationship, DPC C-5
Figure C-2 Excessive Max Power Example . . C-6
Figure C-3 DPC Configuration screen, CLI . . C-9
Figure C-4 DPC dialog, Parameter Editor . . C-10
Figure C-5 DPC Calculate Max Power screen, CLI C-12
Figure C-6 DPC Calibration dialog, Parameter Editor C-12
Figure C-7 Signal Power Levels, Remote SiteC-15

Appendix D Figures

Figure D-1 STDMA Configuration Page, Remote CDM-570/L. D-4
Figure D-2 STDMA Configuration Menu, Hub Type Selection D-5
Figure D-3 STDMA Menu, ECMv2 Hub Type. D-6
Figure D-4 Switch Rate Limits, InBand Return Path Settings Page. D-7

List of Tables

Chapter 2 Tables

Table 2-1 CDD-56X Network Roles and Functions 2-3
Table 2-2 Vipersat Feature Configuration 2-6

Appendix B Tables

Table B-1 STDMA ACK Message B-6
Table B-2 ToS Switching Settings B-20

Appendix C Tables

Table C-1 DPC Parameters, Main Menu C-7
Table C-2 DPC Parameters, Calculate Max Power Menu C-8
Table C-3 Typical Coaxial Cable Characteristics . C-17

{ *This Page is Intentionally Blank* }

CHAPTER

1

GENERAL

How to Use This Manual

This manual documents the enhanced Vipersat features and functions of the CDD-56X Series (CDD-562L, CDD-564, and CDD-564L) of Satellite Network Demodulator Routers, and guides the user in how to configure these products for use in a Vipersat network. The material covered addresses only those areas specific to a CDD-56X running in Vipersat mode, and complements the universal features and functions described in the *CDD-564L Installation and Operation Manual*.

Earth station engineers, technicians, and operators responsible for the configuration and maintenance of the CDD-56X are the intended audience for this document.

Manual Organization

This User's Guide is organized into the following sections:

Chapter 1 — General

Contains CDD-56X product description, customer support information, and manual conventions and references.

Chapter 2 — Quick Start Configuration

Covers the initial basic steps that are necessary for configuring the CDD-56X from a factory default state to a functional network element.

Chapter 3 — Using the Command Line Interface (CLI)

Describes the use of the CLI for configuring and monitoring the CDD-56X in a Vipersat network. Each CLI screen is presented along with a detailed description and related commands.

Appendix A — Network Addressing

Supplemental reference information on binary math and network addressing to assist with integrating the CDD-56X into a Vipersat network.

Appendix B — Automatic Switching

Supplemental reference information on the Vipersat feature that provides load switching (response to network traffic load), application switching (response to traffic type) functions, and Entry Channel Mode switching functions.

Appendix C — Dynamic Power Control

A description of Vipersat's DPC feature and its functionality in a network of CDM-570/CDD-56X series equipment.

Appendix D — ECM Migration

Procedural instructions on migrating a Vipersat network of CDM-570/CDD-56X series equipment from *STDMA Entry Channel Mode* (ECMv1) to *Dynamic Entry Channel Mode* (ECMv2).

Appendix E — Glossary

A glossary of terms that pertain to Vipersat satellite network technology.

Conventions and References

The following conventions are utilized in this manual to assist the reader:

Note: Provides important information relevant to the accompanying text.

Tip: Provides complementary information that facilitates the associated actions or instructions.

Caution: Explanatory text that notifies the reader of possible consequences of an action.

Warning: Explanatory text that notifies the reader of potential harm as the result of an action.

The following documents are referenced in this manual, and provide supplementary information for the reader:

- *CDD-564L L-Band Quad Demodulator with IP Module Installation and Operation Manual* (Part Number MN/CDD564L.IOM)
- *CDM-570/570L Modem Installation and Operation Manual* (Part Number MN/CDM570L.IOM)
- *Vipersat CDM-570/570L User Guide* (Part Number MN/22125)
- *Vipersat CDM-570/L, CDD-56X Parameter Editor User Guide* (Part Number MN-0000038)
- *Vipersat Management System User Guide* (Part Number MN/22156)
- *VLoad Utility User Guide* (Part Number MN/22117)

Product Description

Introduction

The Vipersat CDD-56X Satellite Network Demodulator Router is ideal for operators wishing to supply mesh connectivity between sites, while keeping network infrastructure costs down. The CDD-564 and CDD-564L provide four separate demodulators (the CDD-562L provides two) and an integrated router in a compact, cost-effective 1RU package.

The CDD-56X simplifies Hub site installations by reducing rack space and cost with 2/4 independent demodulators in a single chassis. A bank of CDD-56X demodulators is ideal for a star network consisting of a single outbound carrier at the Hub with multiple carriers returned from the remote sites.

The CDD-56X can be used at Hub sites where multiple burst controllers are needed. Demodulator roles are defined via software, configurable either as a burst controller in STDMA (Selective Time Division Multiple Access) mode, or as dedicated SCPC (Single Channel per Carrier) inbounds from remote terminals.

At Remote sites, the CDD-56X supports mesh connectivity between multiple sites. Operating in mesh topology with links directly between sites eliminates double-hops through the Hub, conserving bandwidth and reducing latency.

Demodulator Features

- 50–90 MHz or 100–180 MHz IF Range, each Demodulator (CDD-564)
  950–1950 MHz IF Range, each Demodulator (CDD-562L/564L)
- QPSK, 8-PSK, and 16-QAM Operation
- Data Rate Range from 16 kbps up to 9.98 Mbps, depending on modulation and FEC used (with FAST feature upgrade)
- Turbo Product Coding (TPC) FEC
- Fast Acquisition Demodulator
- Simultaneous STDMA (burst) and *d*SCPC modes (configurable on a per demodulator basis)
- LNB Support: 10 MHz Reference and LNB Power
- N:M Hub Modem Redundancy Schemes

Router Features

- Fully Integrated Network Management using Vipersat Management System (VMS)

- Single Hop On Demand (SHOD) functions
- 10/100BaseT Ethernet LAN/WAN Interface
- Static IP Routing for Unicast or Multicast
- Header Decompression
- Payload Decompression
- 3xDES Decryption

Network and Bandwidth Management

A Vipersat-powered network solution integrates this advanced demodulator/ router with the powerful network management tool, the Vipersat Management System (VMS). The VMS provides for traditional monitor and control of the CDM-570/570L modems and the CDD-56X demodulators, but more than just an M&C package, the VMS offers unique bandwidth management that is ideal for IP-switched networks. Short data transfers are typically executed using a shared Selective Time Division Multiple Access (STDMA) channel, and when large amounts of data transfer, voice, and/or video communications are needed, these units can be automatically switched to a dedicated SCPC channel.

Dynamic SCPC (*d*SCPC)

The VMS provides for dynamic bandwidth allocation while in SCPC mode, automatically altering the bandwidth based on traffic conditions. This effectively enables the network to better handle connection-oriented applications and reduce network congestion, jitter, and latency.

In a typical Vipersat application used in conjunction with CDM-570/570L modems, the CDD-56X demodulators are drawn from a pool for assignment to a connection-oriented link.

Traffic inbounds from remotes can be switched manually or automatically, application or load triggered, or scheduled, from shared STDMA (burst) mode to a dedicated SCPC connection. The VMS automatically assigns a free demodulator at the Hub to a desired remote inbound, completely eliminating manual intervention. At remote sites, the CDD-56X simplifies Single Hop On Demand (SHOD) applications with direct remote-to-remote connections that do away with double-hops. Once the session is completed, the remote is automatically reverted back to its home state.

The result is an economical and flexible network with bandwidth shared and directed where it is needed for any mix of IP voice, video, and data traffic.

STDMA

The addition of STDMA capability to a Vipersat network allows multiple terminals to share the same satellite resources that would be dedicated to a single terminal in an SCPC configuration. This means that more terminals can be added to the network with minimal additional cost in either satellite bandwidth or Hub Terminal hardware.

Vipersat STDMA thus provides a low cost solution for medium to large sized networks with generally moderate bandwidth requirements, while at the same time providing all the features of the existing Vipersat systems, including the availability of a switched pool of SCPC channels for occasional high bandwidth traffic such as video conferences and large file transfers. Each STDMA upstream channel from the remote terminals to the Hub uses an STDMA frame operating at an aggregate data rate of from 16 kbps to 9.98 Mbps and can support up to hundreds of remote terminals with multiple burst channel inbounds.

Configured as a Hub terminal, the CDD-564/564L provides one demod for receiving an upstream STDMA channel from the remotes, and three demods for receiving three SCPC channels.

Single Hop On Demand

The CDD-56X is ideal for mesh applications such as Vipersat's Single Hop On Demand (SHOD). With the CDD-56X, SHOD (meshed) circuits are easily and economically established between remotes. SHOD provides significant and dynamic connectivity between latency connections without suffering the high costs associated with multiple carriers and/or 1-to-1 multi-receiver links.

Turbo Product Coding

The Comtech Vipersat CDD-56X incorporates a Turbo Product Codec (TPC) error correction, delivering significant performance improvement when compared to Viterbi with concatenated Reed-Solomon. TPC simultaneously offers increased coding gain, lower decoding delay, and significant bandwidth savings.

Header Decompression

Header compression reduces the required Voice over Internet Protocol (VoIP) bandwidth by as much as 60%. Example: a G.729 voice codec operating at 8 kbps will occupy 32 kbps once encapsulated into IP framing on a LAN. Using IP/UDP/RTP Header Compression, the same traffic only needs 10.8 kbps total WAN satellite bandwidth to cross the link. The CDD-56X demods perform header decompression prior to passing the data onto the LAN.

Payload Decompression

Payload compression condenses the size of data frames and reduces the satellite bandwidth required to transmit across the link. Configurable on a per route basis, Payload Compression provides traffic optimization and reduces bandwidth up to 40%. The CDD-56X demods perform payload decompression prior to passing the data onto the LAN.

Data Decryption

The CDD-56X decrypts 3xDES data that it receives. Data encryption, configurable on a per route basis, is used to prevent unauthorized access to data over the satellite link.

New in This Release

The following firmware version incorporates a number of additional features and enhancements.

1.6.11/2.6.11 Release

Dynamic Entry Channel Mode

Dynamic ECM (ECMv2) utilizes a modified slotted Aloha method for Remotes to establish registration in the network and obtain the means for switching into *d*SCPC mode. Rather than sharing an STDMA burst map, as is the method with STDMA ECM, the Remotes rely on communicating with the Hub channel controller through the use of a multicast Transmission Announcement Protocol (TAP) message. This eliminates the restriction in the number of Remotes in an Entry Channel group that is inherent with the burst map method.

Customer Support

Contact Information

Contact Comtech Vipersat Networks Customer Support for information or assistance with product support, service, or training on any Vipersat product.

Mail: 3215 Skyway Court
Fremont, CA 94539
USA

Phone: 1+510-252-1462 ext. 2

Fax: 1+510-252-1695

Email: supportcvni@comtechefdata.com

Web: www.comtechefdata.com

Return Material Authorization

Any equipment returned to Vipersat must have a Return Material Authorization (RMA) issued prior to return. To return a Comtech Vipersat Networks product for repair or replacement:

- Obtain an RMA form and number from Vipersat Customer Support.
- Be prepared to supply the product model number and serial number of the unit.
- To ensure safe shipping of the product, pack the equipment in the original shipping carton.

Reader Comments / Corrections

If the reader would like to submit any comments or corrections regarding this manual and its contents, please forward them to a Vipersat Customer Support representative. All input is appreciated.

CHAPTER

2

QUICK START CONFIGURATION

Introduction

This chapter describes the minimum configuration of a Vipersat CDD-56X Series Demodulator Router that is necessary in order for the equipment to function in a Vipersat network.

The Vipersat CDD-56X Demodulator Router stores its configuration in an ASCII file named the **PARAM** file. Equipment Configuration is typically performed through the use of the Command Line Interface (CLI), particularly the initial configuration. Once the equipment is functioning in the network, additional configuration can be performed via the VMS.

Refer to Chapter 3, “Using the Command Line Interface (CLI)”, for a detailed description on the usage of this feature.

This manual covers the configuration specifics of the CDD-56X when used in a Vipersat network. Refer to the *CDD-564L L-band Quad Demodulator Installation and Operation Manual* for general instruction on setting up, installing and configuring this equipment.

Note: Before attempting to configure a CDD-56X to be used in a Vipersat network, make certain it has the Vipersat option installed and enabled.

Initial Configuration

Note: Many of the settings required for equipment configuration are based on the LAN/WAN and Satellite network design, and should be obtained from the network administrator.

Terminal Connection

These procedures are performed using the CLI from a workstation connected to the CDD-56X either via a direct connection to the **Console** port (a console cable is shipped with each unit), or via a telnet connection to the **Traffic 100** port. Alternatively, HyperTerminal or any of the other connection methods described in the *CDD-564L L-band Quad Demodulator Installation and Operation Manual* may be used.

Make a terminal connection to the target CDD-56X demodulator/router. If connecting via the Traffic 100 Ethernet port (do **not** use the M&C port), enter the IP address of the unit. The factory default IP address for a Vipersat enabled unit is **192.168.254.2**. Configure the terminal for VT-100 emulation mode. Once a terminal connection has been made, the CDD-56X will respond with a Login prompt. The factory defaults for accessing the *Admin level* are:

Login: **comtech**

Password: **comtech**

Once the operator has logged in, the **Main Menu** shown in figure 2-1 is displayed.

Network Role

The first and most important step prior to configuring the CDD-56X is to define its network role.

The CDD-56X is a flexible network component able to perform different functions depending on how it is used in a network. The role that is defined for each CDD-56X will determine what functions are available for each unit to fill its role. Table 2-1 lists the network roles and the corresponding network functions for which the CDD-56X can be configured.

Table 2-1 CDD-56X Network Roles and Functions

		Demod			
Role / Location	**Expansion**	**1**	**2**	**3**	**4**
Hub	No	STDMA	SCPC	SCPC	SCPC
Hub	Yes	SCPC	SCPC	SCPC	SCPC
Remote	Yes	SCPC	SCPC	SCPC	SCPC

The procedure for setting the modem configuration to match the defined network role is presented later in this Quick Start (“Set the Vipersat Configuration” on page 2-10).

Refer to the section “Unit Role” on page 3-38, and the following section “Expansion Unit”, for additional details on setting a CDD-56X’s network role.

Setting Vipersat CDD-56X Operating Parameters

The following is an example of using the CLI to bring a Vipersat CDD-56X with factory default settings to the configuration which allows the Vipersat functions to be accessible.

Set the Feature Configuration

The operating parameters that will be configured in the target CDD-56X are, in part, determined by the role the CDD-56X is to fill in the network, as shown in table 2-1 and table 2-2.

Use the following procedure to configure a CDD-56X to the network role it is to fill in a Vipersat network.

1. From the **Main Menu** shown in figure 2-1, select the **Administration** command by entering **A** at the command prompt.

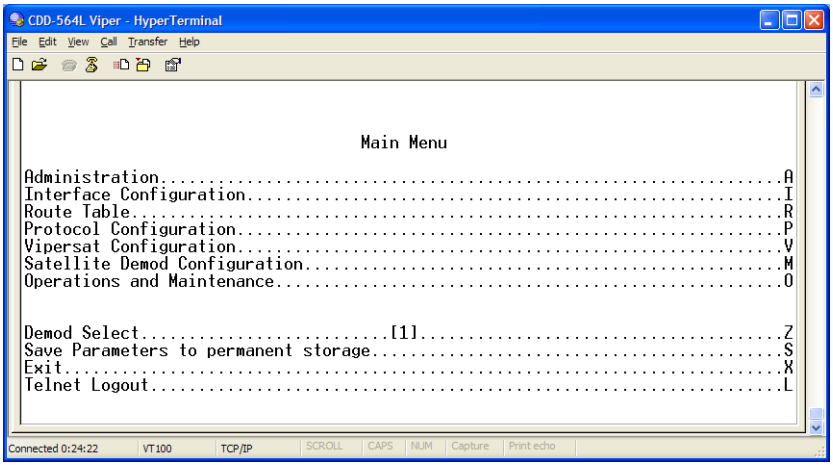


Figure 2-1 Main Menu screen

2. From the **Administration** screen shown in figure 2-2, select the **Features Configuration** command by entering **F** at the command prompt.

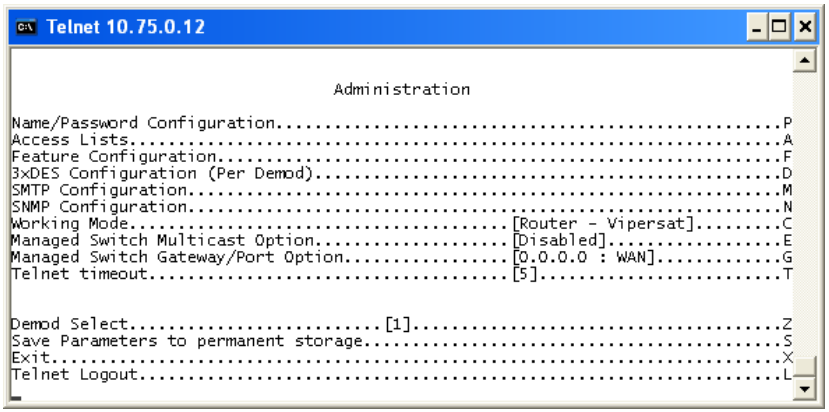


Figure 2-2 Administration screen

3. From the **Feature Configuration** menu shown in figure 2-3, verify whether or not the Vipersat Feature Codes are **Available** (appears as shown in the figure). These codes are entered prior to shipment from the factory; however, if the codes display as **Unavailable**, they will have to be re-entered.

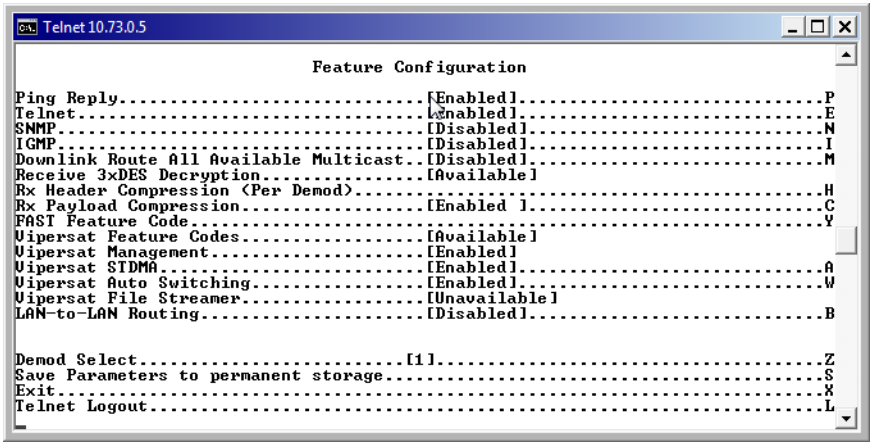


Figure 2-3 Feature Configuration screen

To enter the feature code, enter **Y** at the command prompt, then enter the 20 digit **FAST Feature Code**, as shown in figure 2-4.

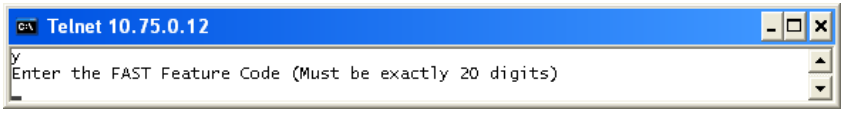


Figure 2-4 FAST Feature Code dialog

Tip: The network administrator will have the FAST Feature codes. These are generated and stored by the unit serial number for the target CDD-56X. The target unit's serial number can be found on the rear of the unit chassis.

4. After entering the FAST Feature code, return to the Administration screen, shown in figure 2-2, and ensure that the **Working Mode** is set to **Router-Vipersat**.

   If it is not, enter **C** and change the setting by selecting **4**, as shown in figure 2-5. The unit will reboot automatically in order to implement the change for this setting.

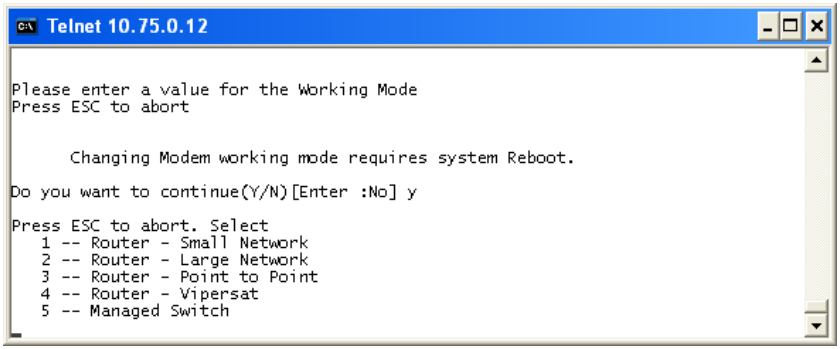


Figure 2-5 Working Mode dialog

5. When the reboot is completed, return to the Feature Configuration menu and configure the settings for **Vipersat STDMA** and **Auto Switching** according to the table below.

Table 2-2 Vipersat Feature Configuration

Unit Role	Vipersat	STDMA	Auto Switching
Hub	Enabled	Enabled	(optional) Enabled
Hub Expansion	Enabled	Disabled	Disabled
Remote Expansion	Enabled	Disabled	Disabled

6. Save the settings to flash by entering **S** at the command prompt.

Set the IP Address

1. From the Main Menu, enter **I** to access the **Interface Configuration** menu screen, then enter **E** to access the **Ethernet Interface** screen (figure 2-6).

2. Enter **I** at the command prompt, and enter the **IP address** for this unit.

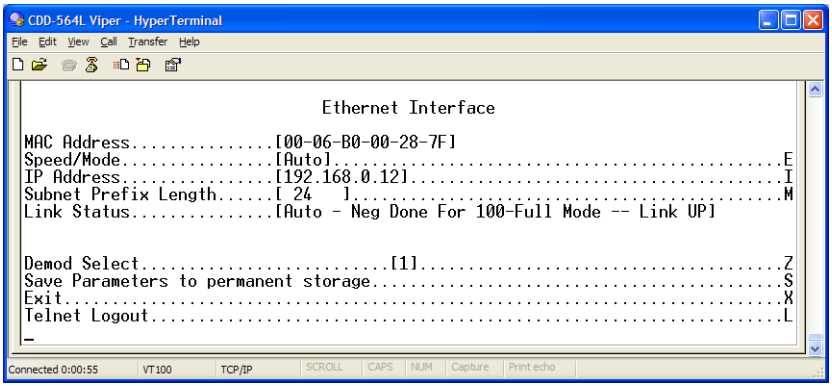


Figure 2-6 Ethernet Interface screen

3. Save the settings to flash by entering **S** at the command prompt.

Configure the Route Table

Routing in a Vipersat Network

CDD-56X Demodulator Routers operating in Vipersat mode do not use the small or large network described in the *CDD-564L Installation and Operation Manual*. There is no HDLC address in a Vipersat network; instead, the CDD-56X role designation — Hub or Remote, Expansion unit or not — determines routing rules that prevent multicast loops. This simplifies the configuration of a Vipersat network.

Because satellite networks are often used as extensions for access to services such as the Internet or the PSTN, they lend themselves quite readily to private addressing. For example, to provide Internet access to the satellite network, only the Hub requires a public IP address in order for the entire satellite network that is controlled by the Hub to have access to the Internet backbone. Utilizing Network Address Translation (NAT), the administrator can effectively address the network using a minimum number of static route statements.

Example:

The IP address 172.16.0.0 is the private address network number for class B networks. If there is a router at the Hub with a connection to the Internet, the operator can define the local network as a class B. If the operator splits the Class B in half and points the upper half toward the satellite there will be over 16000 usable addresses at the Hub as well as at the Remotes. For details on IP addressing, refer to Appendix A, "Network Addressing".

By putting the one route statement “Remotes 172.16.128.0/17 Wan to Sat” in the TDM Hub modem, and by using the route statement “GW 0.0.0.0/0 Wan to Sat” at each of the remote modems, the network will successfully route packets. The remotes can then be sub-netted as class C networks or below. Additional routers at the remotes can be added for unusually large sites, allowing an additional layer of NAT without requiring any more explicit routing within the Vipersat Modem/Routers.

Refer to the *CDD-564L Installation and Operation Manual* for additional information on entering routes.

Creating the Routes

The following procedure outlines the basic route structure that the target CDD-56X will require for its role in the network. One of the key routes that must be created is a gateway address for routing the data traffic that is received by the unit.

1. From the **Main Menu** shown in figure 2-1, select **Route Table** by entering **R** at the command prompt.

2. From the **Configuring the Route Table** screen shown in figure 2-7, enter **1** at the command prompt to set the first route that will define the default gateway.

   In a *Hub* configuration, the default gateway will typically point to a router on the same LAN as the CDD-56X Hub unit.

   In a *Remote* configuration, the default route will typically point to the satellite modem used for communications back to the Hub.

3. When prompted, enter the **Route Name** (GW), the **IP Address**, the **Number of Bits** in the subnet mask, the **Route Interface** (Ethernet or Satellite), and the **Next Hop** address. The system administrator can supply this information, if necessary.

   In a Hub role, for example, enter the name of the route (e.g., GW), enter **0.0.0.0** for the destination IP address and **0** for the mask, enter **E** for Ethernet interface, then enter the **IP address** of the appropriate router or modem for the next hop.

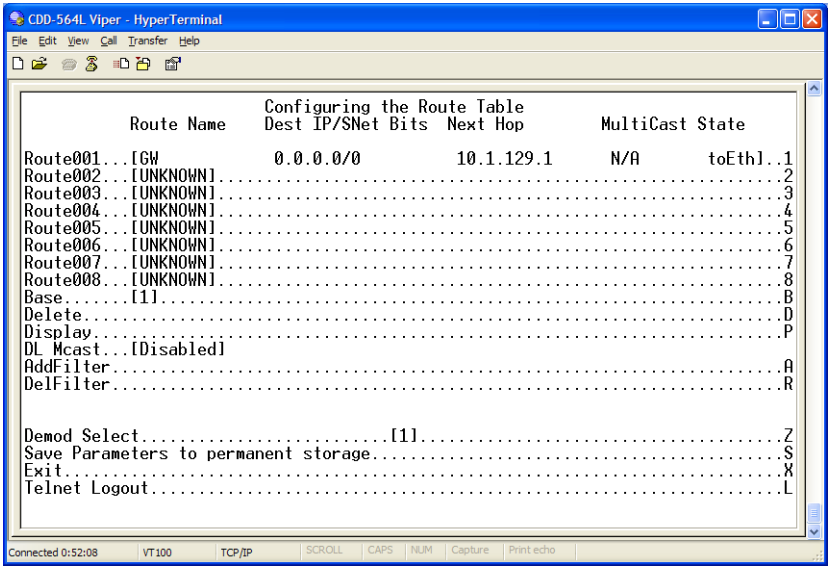


Figure 2-7 Configuring the Route Table screen

4. Enter **S** at the command prompt in figure 2-7 to save the settings to flash.

Set the Satellite Demod Configuration

1. Enter **M** from the **Main Menu**, then enter **C** from the **Satellite Demodulator** menu to access the **Configuration** screen.

2. Enter **R** to access the **Rx Configuration** screen shown in figure 2-8. Set the Rx parameters for **Frequency**, **Data Rate**, **FEC**, **Code Rate**, and **Modulation** as specified by the network administrator.

   The Receive parameters must be set for each Demod. Enter **Z** at the command prompt to select the desired Demod, then set the Receive parameters for that Demod. Repeat for each Demod.

NOTE

Note: Only **Turbo** Product Coding is acceptable for FEC when the CDD-56X is running in Vipersat mode.

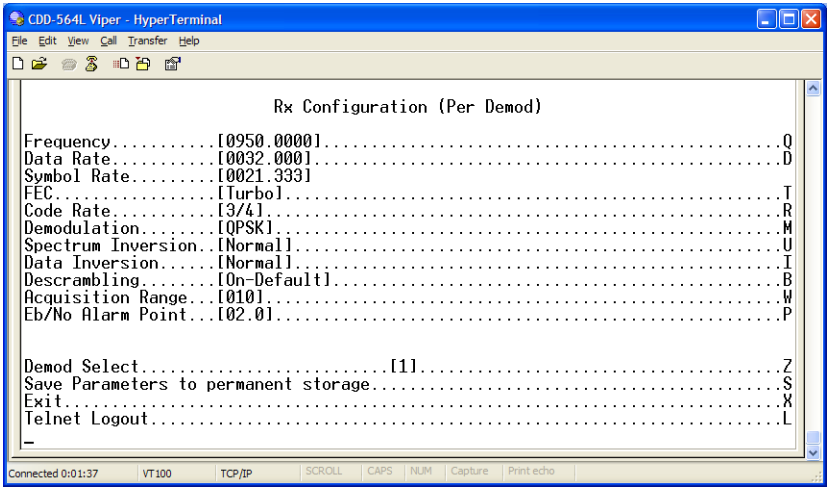


Figure 2-8 Rx Configuration screen

3. Save the settings to flash by entering **S** at the command prompt.

Set the Vipersat Configuration

1. Enter **V** at the **Main Menu** command prompt (figure 2-1) to select the **Vipersat Configuration** menu shown in figure 2-9.

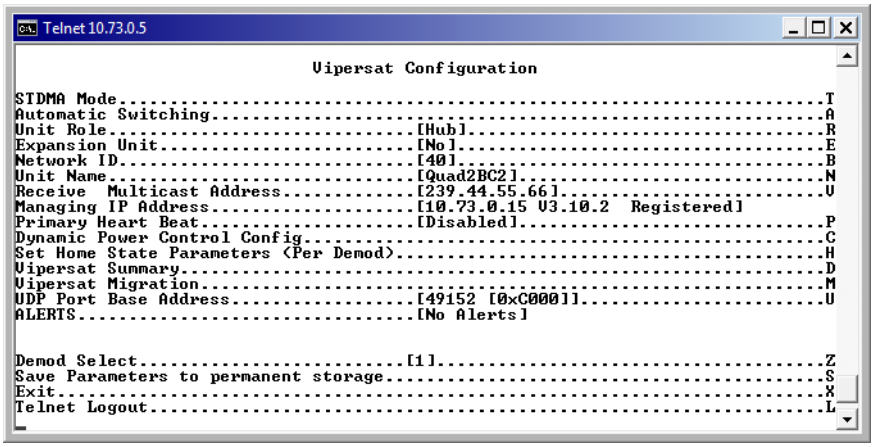


Figure 2-9 Vipersat Configuration screen (Hub)

2. Enter **R** at the command prompt to toggle the **Unit Role** to either **Hub** or **Remote**.
   This parameter will determine the role the target CDD-56X will perform in the network and what type of commands and functions it will receive from the VMS.

3. Enter **E** to set the **Expansion Unit** value to either **Yes** or **No**.
   When configured as an Expansion unit, either as a Hub (switched) or as a Remote (mesh), the CDD-56X is set up so that all Demods are in SCPC mode and available as resources for dedicated communications with the other end of the satellite link.

4. Enter **B** at the command prompt to set the **Network ID**.
   The Network ID that is assigned to the unit defines to what network the target CDD-56X will belong. All units used in a network will have the same Network ID. This parameter is used by the VMS to identify units common to a network and allows the VMS to manage multiple networks, each with its own unique network ID number.

5. Enter **N** at the command prompt to set the **Unit Name**.

6. Enter **V** at the command prompt to set the **Receive Multicast Address**.
   This IP address is the multicast address assigned to the VMS and to all units in the network that are managed by the VMS. The Receive Multicast Address of this CDD-56X must match the Transmit Multicast Address that has been assigned to the VMS.

7. Enter **I** at the command prompt to set the **Managing IP Address**.
   The Managing IP Address is the IP address of the VMS server.

8. Management Security (*Optional*)
   If this is an encrypted network, enter **K** at the command prompt to configure **Vipersat Management Security**.

9. Enter **H** to go to the **Home State Configuration** menu screen, then enter **W** to set the current configuration as the Home State.

10. Save the settings to flash by entering **S** at the command prompt.

This completes the initial configuration of a CDD-56X from the factory default settings to a functioning, Vipersat-enabled unit. Additional configuration parameters must be set depending on the network requirements for a specific application.

Refer to Chapter 3, “Using the Command Line Interface (CLI)”, for additional details on configuring the target Vipersat CDD-56X.

CHAPTER

3

USING THE COMMAND LINE INTERFACE (CLI)

General

This chapter describes the use of the CLI for configuring and monitoring the CDD-56X Demodulator/Router in a Vipersat network. Each CLI screen related to a CDD-56X operating in Vipersat mode is presented, along with a detailed description of the available commands. For descriptions of all other screens, refer to the *CDD-564L L-Band Quad Demodulator Installation and Operation Manual*.

Access to the CLI is provided through either the **Console** port (local, RS-232) or the 10/100BaseT Ethernet **Traffic** port (Telnet, IP). Access via Telnet requires login with password, Console access does not require login. The screens presented in this document are as they appear when the CDD-56X is accessed using Telnet.

When a Telnet terminal connection is made, the CDD-56X responds with a Login prompt. The factory defaults are:

Login: **comtech**

Password: **comtech**

Once the operator has logged in, the **Main Menu** shown in figure 3-1 is displayed.

Common Screen Commands

The following commands appear on each of the menu screens:

Demod Select

Some feature configurations apply to the CDD-56X as a unit, others are set on a **per Demod** basis. This command (enter **Z**) allows the selection of one of the two (CDD-562L) or four (CDD-564/564L) Demodulators.

Save Parameters to Permanent Storage

To **Save** the current parameter settings to permanent storage, enter **S** at the command prompt. This command saves all data that has been entered from any of the CLI screens since the last save was executed. Exiting a screen without saving after parameters have been changed does not mean that the changes are not applied. However, if these changes are not saved prior to a system reset or power cycle, they will be lost.

Exit

To **Exit** the current menu screen and return to the previous screen in the menu tree, enter **X** at the command prompt.

Telnet Logout

Enter **L** at the command prompt to **Logout** of the Telnet session. This command appears only when connected via Telnet.

Menu Descriptions

This section details the CLI menus and associated screens, and briefly discusses the function of each of the commands available on each menu.

Main Menu

The **Main Menu**, shown in figure 3-1, allows configuring both the Demodulator and Router functions of the target CDD-56X.

NOTE

Note: The menu item **Vipersat Configuration** shown in figure 3-1 will only be displayed if the target CDD-56X has had the Vipersat option enabled as described in the section “Setting Vipersat CDD-56X Operating Parameters” on page 2-3.

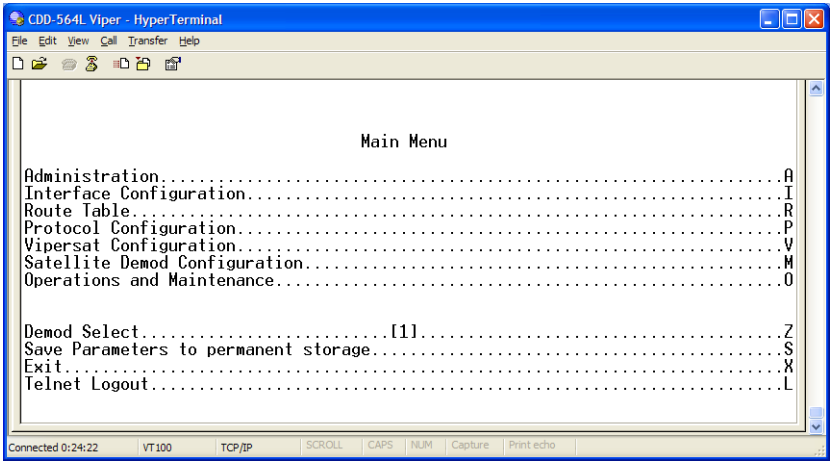


Figure 3-1 Main Menu screen

A Vipersat CDD-56X is normally shipped with the Vipersat option enabled. The CDD-56X configuration can be determined by whether or not the command line **Vipersat Configuration** is displayed on the menu, as shown in Figure 3-1.

Administration

The **Administration** menu provides access to the major Vipersat CDD-56X features and commands. Entering an **A** at the prompt in the **Main Menu**, shown in figure 3-1, displays the **Administration** screen shown in figure 3-2.

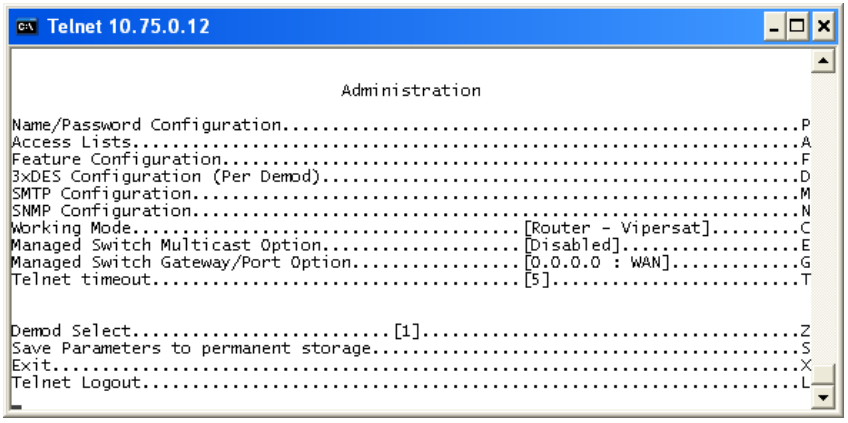


Figure 3-2 Administration screen

Ensure that the **Working Mode** is set to **Router-Vipersat**.
If it is not, enter **C** at the command prompt and change the setting by selecting **4**, as shown in figure 3-3. The unit will reboot automatically in order to implement the change for this setting.

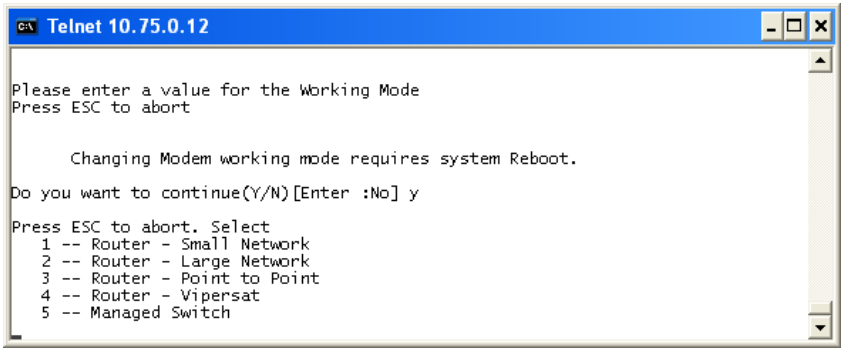


Figure 3-3 Working Mode dialog

NOTE

Note: If the Router-Vipersat option does not appear as a selection, the Vipersat Feature Code has not yet been entered into this unit. Input the Vipersat code as described in the next section..

From the Administration menu, enter an **F** at the prompt to display the **Feature Configuration** screen shown in figure 3-4.

Feature Configuration

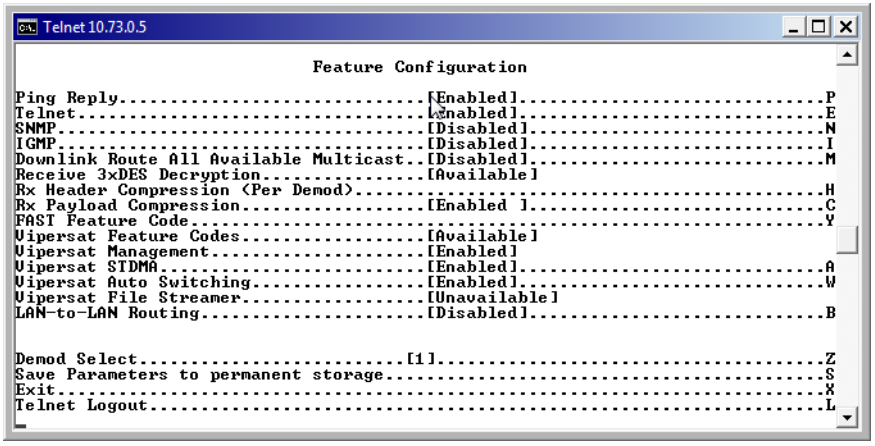


Figure 3-4 Feature Configuration screen

The **Feature Configuration** screen shown in figure 3-4 allows the **Enabling** and **Disabling** of the major Vipersat CDD-56X features.

Use this screen to enable and disable Vipersat features such as:

- **Vipersat STDMA** — Burst mode operation
- **Vipersat Auto Switching** — Allows switching to SCPC mode
- **Vipersat File Streamer** — Rapid file transfers over satellite network

NOTE

Note: These Vipersat features must be Enabled or Disabled using this menu. They are not accessible from the Vipersat Configuration menu.

Vipersat Feature Codes

From the Feature Configuration menu, verify whether or not the Vipersat Feature Codes are **Available** (appears as shown in figure 3-4). These codes are entered prior to shipment from the factory; however, if the codes display as **Unavailable**, they will have to be re-entered. To enter the FAST Feature code, enter **Y** at the command prompt.

The Vipersat FAST Feature Codes can be entered as 20 hexidecimal digits at the command prompt as shown in figure 3-5.

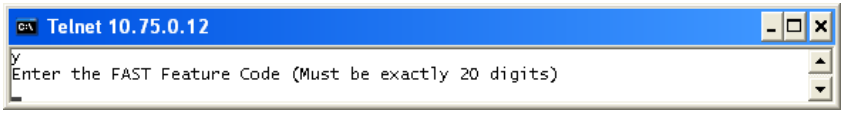


Figure 3-5 FAST Feature Code dialog

Tip: Contact either the network administrator or Comtech Vipersat Networks Customer Support to obtain the Feature codes. A convenient option is to use the Vipersat Vload utility to manage Feature codes.

Vipersat Management

This item is an information-only display, and indicates whether **Vipersat Management** is Enabled or Disabled in the target CDD-56X. Activation of the Vipersat Feature Code automatically enables the Vipersat Management feature.

Caution: This command must be **Enabled** in order to utilize any of the Vipersat capabilities of the CDD-56X.

Vipersat STDMA

In order to utilize the **Vipersat STDMA** feature (burst mode) in the target Vipersat CDD-56X, this feature must be **Enabled**. Enter **A** at the command prompt to toggle On or Off.

Refer to table 2-2 for the relationship between Unit Role and STDMA. This feature should only be enabled for a unit that is used as a Hub with no expansion (i.e., a Burst Controller).

Note: Although the CDD-56X has multiple demods, STDMA is configurable for only one demod. When this parameter is enabled, Demod 1 is set for STDMA mode and the remaining demods are set for SCPC mode.

Vipersat Auto Switching

The **Vipersat Auto Switching** feature allows the CDD-56X to automatically adjust to varying bandwidth demands in the Vipersat network by switching between STDMA and SCPC connections. This feature should only be enabled for a unit that is used as a Hub with no expansion, and that will be required to send switching requests to the VMS in response to either traffic type (Application switching) or network traffic loads (Load switching). Refer to table 2-2 for the relationship between Unit Role and Auto Switching.

To activate the Vipersat Auto Switching capabilities of the target CDD-56X, toggle the Auto Switching command to **Enabled** by entering **W** at the command prompt.

See the section “STDMA/SCPC Automatic Switching” on page 3-32 for more details on the use of this feature. For additional information, refer to Appendix B, “Automatic Switching”.

Vipersat File Streamer

Vipersat File Streamer (VFS) is an optional feature that allows rapid file transfers over the satellite network between host PCs that are running the client VFS application. To activate the Vipersat File Streaming capabilities of the CDD-56X, toggle this command to **Enabled** by entering **R** at the command prompt.

Once the parameters on the Feature Configuration screen have been set as desired, return to the Main Menu and enter the **V** command to display the **Vipersat Configuration** screen shown in figure 3-6.

Vipersat Configuration

Entering **V** at the prompt from the CDD-56X **Main Menu** shown in figure 3-1 displays the **Vipersat Configuration** menu shown in figure 3-6.

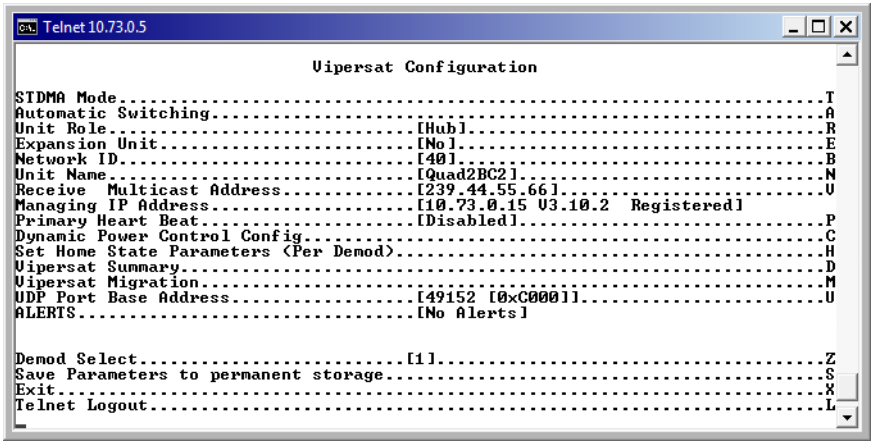


Figure 3-6 Vipersat Configuration screen (Hub)

This menu lists the available commands for configuring a Vipersat CDD-56X. Note that for the Hub unit only, the command **Primary Heart Beat** is displayed in the Vipersat Configuration screen. For the Remote unit only, the status of the **Home State Revert** setting is displayed.

Each of these commands is explained in the following sections.

STDMA Mode

The **STDMA Mode** parameters for this CDD-56X are accessed by entering **T** at the **Vipersat Configuration** screen command prompt.

The items in the **STDMA** menu will vary depending on the function the target CDD-56X performs in the network (Hub or Remote) and the Hub Type that is designated. The STDMA screen shown in figure 3-7 is from a CDD-56X serving as a Hub with STDMA in the network. The Hub Type is designated as *Fixed*, in this example.

For comparison, the STDMA screen for a CDD-56X operating in SCPC mode (either as a Hub expansion unit or as a Remote mesh unit) is shown in figure 3-8. Note that some of the command items differ between these two screens, and most of the items on the SCPC menu are information-only display..

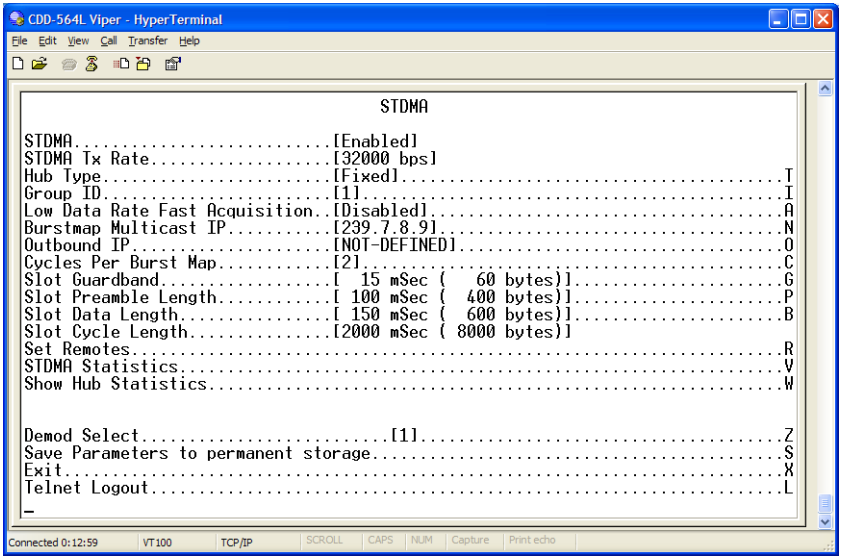


Figure 3-7 STDMA screen (Hub, STDMA, Fixed type)

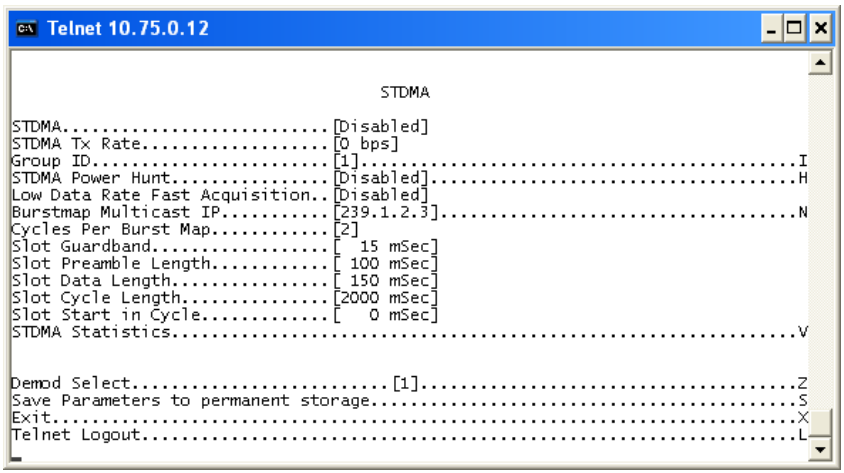


Figure 3-8 STDMA screen (Hub/Remote, SCPC)

STDMA

This menu item is read-only and shows the current state of **STDMA** in the CDD-56X. In order to change the STDMA state, refer to the section “Feature Configuration” on page 3-5.

STDMA Tx Rate

This menu item shows the STDMA Transmit Rate (in bps) of data that the CDD-56X receives. This item is read-only and cannot be modified in this menu.

Hub Type

This menu item is only displayed if the CDD-56X is being used as a Hub in the network, and provides the functionality for the STDMA Burst Controller. Vipersat STDMA has six modes of operation:

- **Fixed** — all remotes get the same data slot time (slot size) in the cycle, regardless of activity. Cycle time is fixed also.
- **Dynamic Slot** — data slot time of remotes vary according to activity, cycle time does not.
- **Dynamic Cycle** — slot time and cycle time vary according to activity of remotes.
- **GIR** (Guaranteed Information Rate) — each remote always has at least the minimum data slot size when needed, and cycle time is variable up to a maximum of one second.
- **Entry Channel** — remotes run in SCPC mode, but STDMA is used for maintenance and control channel.
- **ECMv2** — utilizes a modified slotted Aloha method for remotes to establish registration in the network and obtain the means for switching into SCPC mode.

The Hub can be configured to operate as one of the six types by entering a **T** at the command prompt to display the dialog shown in figure 3-9.

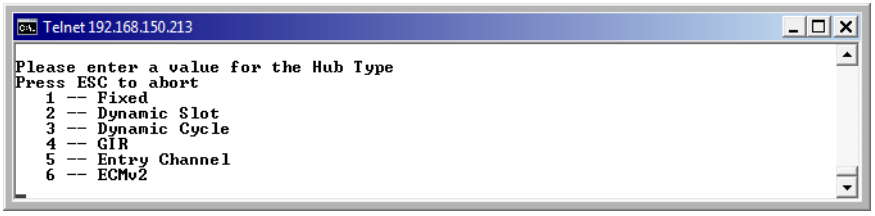


Figure 3-9 Hub Type prompt

This selection determines whether available bandwidth will be a static (fixed) assignment, or whether bandwidth allocation will be dynamic with automatic switching to dynamically optimize bandwidth utilization.

Refer to Appendix B, “Automatic Switching”, for additional information on how each of the bandwidth allocation modes functions and the parameters used to calculate the commands for each mode.

1 – Fixed

In the **Fixed** mode, all remotes have the same data slot size regardless of type of traffic or load. This mode minimizes the amount of jitter between remote transmission times, and is useful for tuning STDMA as well as for troubleshooting purposes.

2 – Dynamic Slot

In the **Dynamic Slot** mode, slot size is adjusted each cycle depending on the activity during the previous cycle. The slot size for each remote is computed based on the time (at the current data rate) needed to transmit all the bytes in queue. If the result is less than the minimum slot size or more than the maximum slot size, the slot is adjusted accordingly. This mode allows the burst controller to provide additional slot time in the cycle to remotes with higher traffic demands, and helps to alleviate congestion.

3 – Dynamic Cycle

In the **Dynamic Cycle** mode, available bandwidth is allocated to remotes proportionally based on their current bandwidth needs. The bandwidth requirements are determined by the number of bytes in queue for each remote divided by the total number of bytes in queue for all remotes, and results in the percentage of bandwidth to allocate for each remote. This mode provides improved efficiency of STDMA due to faster cycle times during periods of light traffic demands, thus providing minimum latency for the current load.

4 – GIR

In the **GIR** mode, the initial computed slot size value is the same as in the Dynamic Cycle mode except there is no maximum limit. After all remotes have been assigned slots, the burst map is checked to see if the total cycle length exceeds one second. If not, then all requirements are satisfied and the burst map is complete. However, if the cycle is greater than one second, then the slots are adjusted proportionally so that all remotes receive at least their guaranteed rate plus whatever excess is still available.

GIR mode allows guaranteed information rates to be set for each remote in the group. When the one second restriction is exceeded, remotes without a specified GIR are reduced to the global minimum slot size and the remaining bandwidth is distributed to remotes that have been assigned a GIR rate, thus ensuring additional bandwidth to these units when needed.

Note: GIR allocations are restricted so that assigned GIR totals cannot exceed the available bandwidth. This ensures proper bandwidth allocation when the network is overloaded.

The GIR setting for each Remote is specified using the STDMA Remote Policies screen (refer to the section "Set Remote Policies" on page 3-24). When combined with Auto switching, GIR allows trigger points to be set where the Remote will jump out into SCPC mode. This is done using the Load Switch setting. Note that, for this function, Auto switching must be Enabled on this Hub unit, and corresponding Remote modems must be configured with Auto switching and Load switching Enabled. Also, the settings for Step Up and Step Down Threshold values should be adjusted as necessary for the application.

5 – Entry Channel

The **Entry Channel** mode provides remotes in the group with a shared channel in which they can gain initial access to the network. Since very small STDMA data rates are required in this configuration, a larger number of remotes can share the cycle. As soon as the Hub receives an STDMA ACK from the Remote, it initiates an immediate switch to SCPC mode based on the policy set for that Remote. Note that the switch occurs as soon as the Hub receives an ACK even though there may not be traffic at that time. The persistence of the link will be determined by the unit's flag settings.

When choosing Entry Channel as the Hub type for the STDMA Controller, the Auto switching feature must be Enabled on this Hub unit, and switching policies for the remotes must be configured (refer to the section "Set Remote Policies" on page 3-24). Corresponding Remote modems must be configured with Auto switching and Load switching Enabled. Note that the settings for Step Up and Step Down Threshold values should be adjusted as necessary for the application.

This mode is designed to accommodate the needs of a Remote that will not be continuously connected to the network, but which has the need to be able to make an on-demand connection when required, such as in a mobile application. In the event of a power outage, Entry Channel provides a bandwidth-efficient method for remotes with low latency requirements to re-enter the network once power is restored.

6 – ECMv2

The **ECMv2** (*Dynamic Entry Channel*) mode is very similar to the regular Entry Channel mode. However, the associated limitation in the number of Remotes is eliminated via the modified slotted Aloha method that is utilized for this mode. No cycle is used, and a Remote List is not necessary.

The Hub broadcasts an anouncement message to all Remotes that are tuned to receive it that provides the available slots and the tuning parameters for trans-

mitting back to the Hub. The Remotes transmit on a contention basis and should a collision occur, the Remote will back off for a specified period and try again. Once it obtains one of the available slots, the Remote will hold onto the slot until it registers with the VMS and receives assignment into *d*SCPC, or until all necessary transactions are completed. The slot is then released for use by another Remote unit that is attempting to enter the channel.

Remotes can be set to one of four operating modes—*Disable*, *Offline*, *Wait*, and *Online*—from the ECMv2 Mode command in the STDMA menu. In addition, commands for setting parameters to accomodate any mismatches between the Hub LNB and the Remote BUCs are presented: *LNB LO Frequency* (Hub), *BUC LO Frequency* (Remote), and *Satellite Conversion Frequency*.

ECMv2 Mode

This menu item appears for Hub expansion and Remote expansion units operating in ECMv2 only.

Each unit can be set to a designated mode of operation in ECM:

- **Disable** – the ECM function for this unit is disabled.
- **Offline** – the unit will not transmit (muted).
  This mode may be chosen for radio silence applications.
- **Wait** – the unit will register with the controller and remain in the ECM wait queue without assignment for switching into *d*SCPC mode. This mode may be chosen by operators who wish to manually control (via diagnostic switch) when a unit is to be switched and utilize bandwidth from the pool.
- **Online** – the unit will register with the controller and request *d*SCPC bandwidth for switching.

In order for a unit to automatically switch into SCPC mode and pass data traffic, the ECMv2 Mode *must be set to Online*.

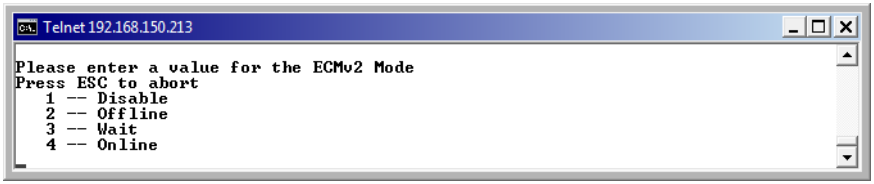


Figure 3-10 ECMv2 Mode prompt

Tip: For purposes of commissioning the terminal with a continuous carrier, the Entry Channel mode can be set temporarily to *Disable*. Once this process is completed, set the Remote back to the desired mode for normal operation.

Group ID

The STDMA **Group ID** number defines a group of equipment (including CDD-56X Hub and Remote units) that will respond to the output of a single STDMA burst controller. This group is addressable within a network which, in turn, is defined by the Network ID number assigned to the CDD-56X.

Allocation of bandwidth is shared among the remotes in an STDMA group. Depending on the number of remotes in a network, a Hub may have multiple burst controllers, each with its own set of remotes. This is accomplished by assigning a unique Group ID number to each controller and its associated remotes.

NOTE

Note: The STDMA Group ID number and the Network ID number are independent. There can be multiple STDMA groups within a single network.

The target CDD-56X Group ID can be modified by entering an **I** at the command prompt to display the dialog shown in figure 3-11.

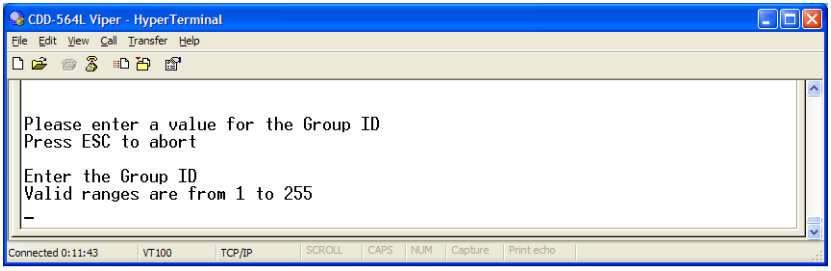


Figure 3-11 Group ID prompt

STDMA Max Power Hunt

This menu item appears for Remote modems only.

Should link reception from a Remote be incorrect or impaired (e.g., poor environmental conditions), the **STDMA Max Power Hunt** feature is an option on the Remote modem that automatically adjusts the Remote transmit power to ensure that burst map acknowledgements from that unit are received by the Hub burst controller. When enabled, the burst controller sets a flag in the burst map that indicates it is not receiving acknowledgements from an enabled Remote. When the Remote receives the burst map, it will see the flag and automatically increase power up to the maximum value specified with this parameter (3, 6, or 9 dB) above the default or Home State setting. If this closes the link, the burst controller will clear the flag. Note that if the dB increase is more than is necessary, DPC will make a down adjustment to the appropriate level and this adjustment will be added to the DPC Offset.

This feature option is Enabled/Disabled by entering **H** at the command prompt.

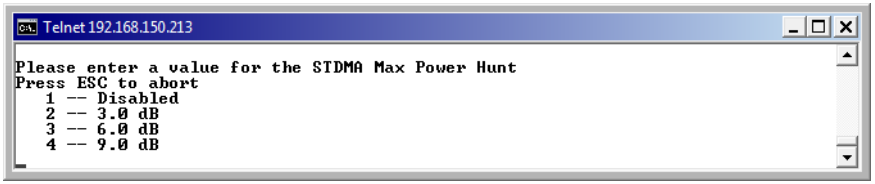


Figure 3-12 STDMA Max Power Hunt prompt

Low Data Rate Fast Acquisition

Configurable on a Hub Burst Controller only.

This menu item is a toggle used to Enable or Disable the Vipersat **Burst Fast Acquisition Timing (BFAT)** feature that functions at low data rates (64 kbps to 256 kbps). This feature allows for significantly faster acquisition times at these data rates, even with higher noise, resulting in improved efficiency of the shared STDMA channel. Since signal lock is faster at higher data rates, BFAT is not active above 256 kbps.

Entering **A** at the command prompt will toggle this feature On or Off.

This feature requires Router firmware version 1.5.3 or later. The unit configuration must be set for operation at either 3/4 QPSK or .95 QPSK in order to utilize BFAT.

NOTE

Note: Use of BFAT is NOT recommended with ECMv2.

When this feature is enabled with any other STDMA allocation method, the Preamble parameter becomes fixed (not settable by the user) and this value is automatically determined by the system—appears as display only in the CLI; not displayed in the Parameter Editor.

Burstmap Multicast IP

This menu item is used to define the IP address for the Burstmap Multicast that is sent out by the STDMA burst controller at the Hub to all of the associated remotes in that group. This address must be the same for all members of the goup. The burstmap is a proprietary message sent from the Hub to all remotes, at regular intervals, specifying the relative start time and duration for each terminal to transmit.

To change the current address, enter **N** at the command prompt to display the dialog shown in figure 3-13.

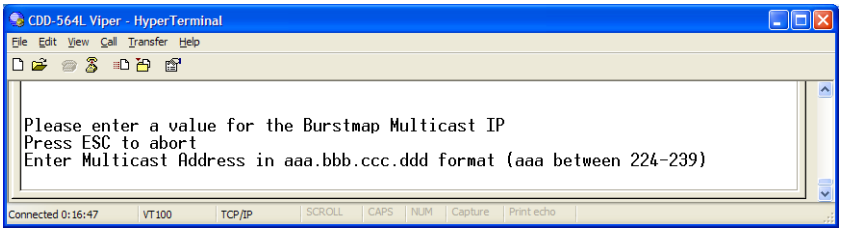


Figure 3-13 Burstmap Multicast IP prompt

Outbound IP

This menu item, which appears for all Hub configurations, displays the current Outbound IP address. This specifies the Hub device that is supplying the TDM outbound to the satellite (typically a CDM-570L). Specifying this address is necessary for Hub configurations that utilize a burst controller (such as the CDD-56X) that is a separate device from the TDM modem.

This address must also be defined when using the following features:

- DPC
- SOTM

The Outbound IP address will be the same as the burst controller IP address when the burst controller and the TDM modem are the same device.

To define the TDM outbound address, enter **O** at the command prompt to display the dialog shown in figure 3-14.

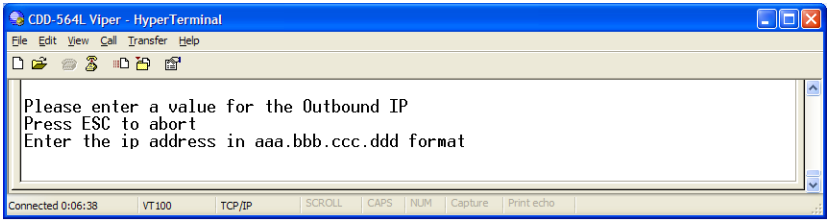


Figure 3-14 Outbound IP prompt

Cycles Per Burst Map

This menu item, which appears for Hub types *Fixed*, *Dynamic Slot*, and *Entry Channel*, displays the number of spin cycles that will occur prior to each broadcast of the Burst Map by the burst controller to the remotes. One cycle is the amount of time it takes for all remotes in a group to burst on the common channel. The burst map provides each remote with its allocated bandwidth and position in the cycle.

For Dynamic Cycle and GIR configurations, the number of cycles is automatically set to one in order to ensure optimum performance for these Hub types.

This parameter can be modified by entering a **C** at the command prompt to display the dialog shown in figure 3-15.

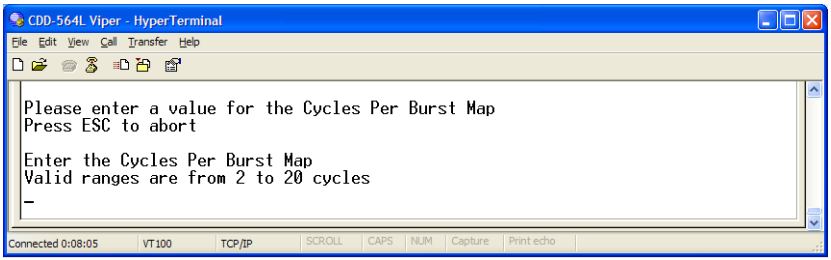


Figure 3-15 Cycles per Burst Map prompt

Slot Guardband

This menu item, which appears for all Hub configurations, displays the current length of the Slot Guardband in milliseconds and in bytes for the remotes in the group. The Slot Guardband is the amount of time between the point when one remote completes transmitting data and the point when the next remote in the cycle begins transmitting. This prevents the remote from overrunning the next terminal in the cycle. The setting for this parameter should be obtained using the *Vipersat STDMA calculator*.

Tip: For a copy of the latest Viper Calculator, contact a Comtech Vipersat Networks representative.

This value can be modified by entering a **G** at the command prompt to display the dialog shown in figure 3-16 and entering a new value.

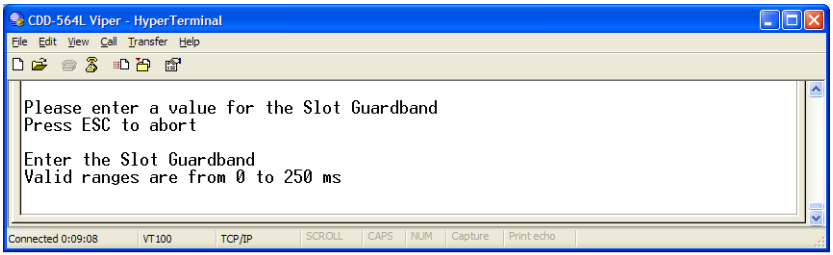


Figure 3-16 Slot Guardband prompt

Note: The value entered at the command line in figure 3-16 is in milliseconds. The corresponding value expressed in bytes is calculated by the

CDD-56X based on the STDMA transmit bit rate as shown in the menu in figure 3-7.

Slot Preamble Length

This menu item, which appears in all Hub and Remote configurations, displays the current Slot Preamble size in milliseconds and bytes for the remotes in the group. The Slot Preamble is the period between when the remote begins to transmit (sends an ACK) to the Hub and when the first data packet is sent. This allows time for signal lock to occur before data is sent, thus preventing data loss. Higher data rates allow for a shorter preamble, since it is easier to achieve signal lock. The setting for this parameter should be obtained using the *Vipersat STDMA Calculator*.

Tip: For a copy of the latest Viper Calculator, contact a Comtech Vipersat Networks representative.

Note: When either the BFAT feature is enabled or the Hub Type is ECMv2, the preamble length is set automatically for the unit.

On a Hub unit, entering a **P** at the command prompt allows changing the preamble duration in milliseconds.

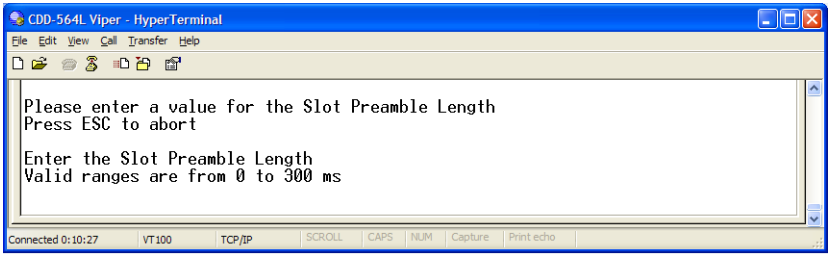


Figure 3-17 Slot Preamble Length prompt

Slot Data Length

This menu item, which appears for *Fixed*, *Entry Channel*, and *ECMv2* Hub types, displays the current **Slot Data Length** in milliseconds and bytes for the remotes in the group, and represents the amount of data that can be transmitted or received in one spin of the STDMA cycle by each of the remotes belonging to that group. This is the amount of time that the remote is provided to send data in the cycle.

To change this setting, enter **B** at the command prompt to display the dialog shown in figure 3-18.

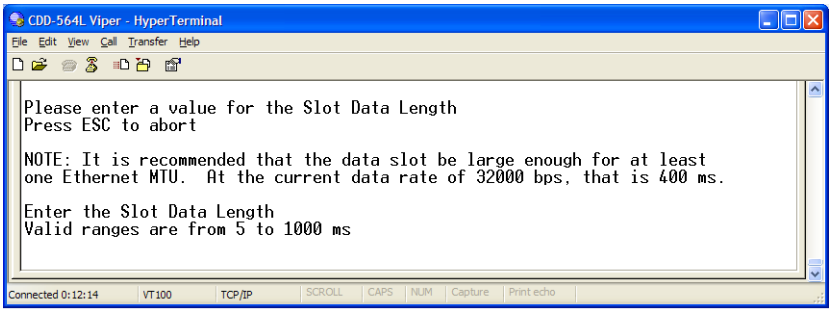


Figure 3-18 Slot Data Length prompt

Nominal Data Length

This menu item, which appears for *Dynamic Slot* Hub type, displays the **Nominal** slot **Data Length** in milliseconds and bytes for the remotes in the group, and represents the approximate amount of data that can be transmitted or received in one spin of the STDMA cycle by each of the remotes belonging to that group. This is the amount of time that the remote is provided to send data in the cycle.

Entering a **B** at the command prompt brings up the dialog shown in figure 3-19 allowing changing the nominal data length, in milliseconds, for the target CDD-56X.

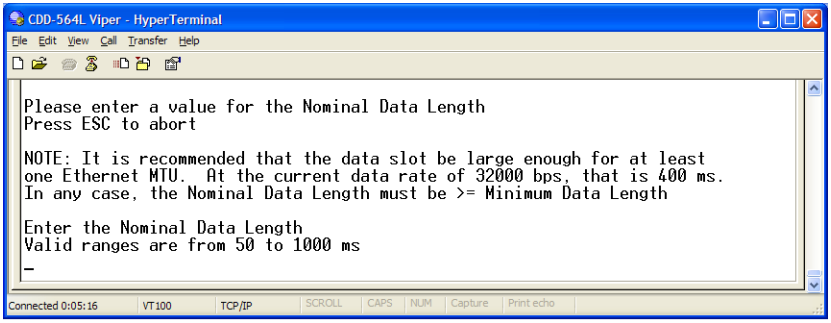


Figure 3-19 Nominal Data Length prompt

Maximum Data Length

This menu item, which appears for *Dynamic Cycle* Hub type, displays the current **Maximum Data Length** in milliseconds and bytes for the remotes in the group, and represents the maximum amount of data that can be transmitted or received in one spin of the STDMA cycle by each of the remotes belonging to that group. This is the maximum amount of time that the remote is provided to send data in the cycle.

To change this setting, enter **B** at the command prompt to display the dialog shown in figure 3-20.

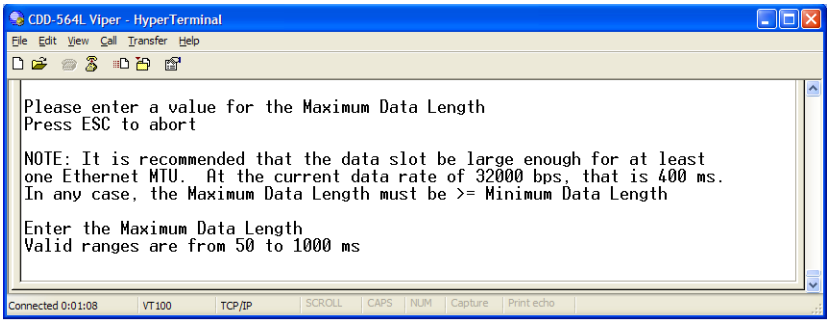


Figure 3-20 Maximum Data Length prompt

Minimum Data Length

This menu item, which appears for *Dynamic Slot*, *Dynamic Cycle*, *GIR*, and *Entry Channel* Hub types, displays the current **Minimum Data Length** in milliseconds and bytes for the remotes in the group, and represents the minimum amount of data that can be transmitted or received in one spin of the STDMA cycle by each of the remotes belonging to that group. This is the minimum amount of time that the remote is provided to send data in the cycle.

Entering an **M** at the command prompt brings up the dialog shown in figure 3-21 allowing the minimum data length, in milliseconds, to be changed for the target CDD-56X.

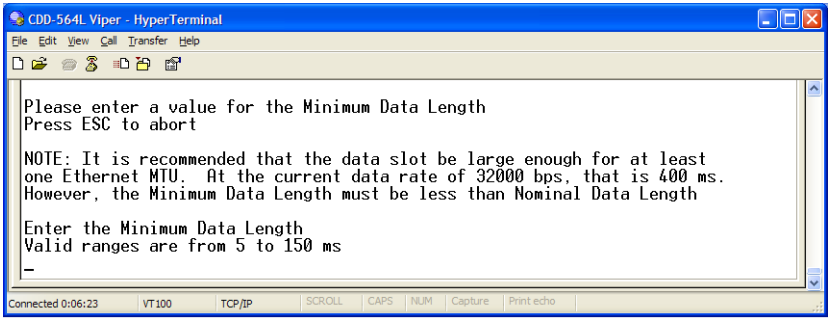


Figure 3-21 Minimum Data Length prompt

Total Slot Count

This menu item appears for Hub units operating in ECMv2 only.

This parameter defines the number of time slots per cycle available for assignment to the Remotes in queue that are to be switched from ECM into *d*SCPC. These are the Remotes that are tagged for **Online** mode. By design, ECM works on a contention basis, with the number of slots being some fraction of the total number of Remotes. In order for this ratio to be optimized, a Vipersat calculator is available to determine this setting.

Tip: Contact a Comtech Vipersat Networks representative for a copy of the latest *Vipersat ECM Calculator*.

Entering **R** at the command prompt allows changing the slot count.
Valid range is 1 to 255.

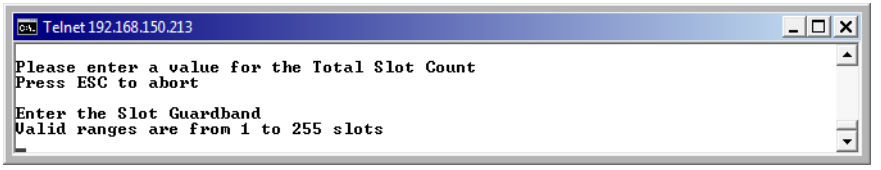


Figure 3-22 Total Slot Count prompt

Slot Cycle Length

This menu item is for information only and displays the **Slot Cycle Length** in milliseconds and bytes for the remotes in the group. This value represents the total amount of time—preamble, data length, and guardband—allocated to the Remote terminal during one spin cycle.

Slot Start in Cycle

This menu item appears in the STDMA screen when the Unit Role is Remote; however, it is not relevant since a Remote configuration does not enable STDMA.

Set Remotes

This menu item appears in the STDMA screen when the Unit Role is **Hub** with **No Expansion**, *except for Hub Type ECMv2*.

Entering an **R** at the command prompt displays the **STDMA Remotes Menu** as shown in figure 3-23. This screen is used to define and make modifications to the Remotes that belong to the STDMA group for the Hub burst controller, as well as to display the burst map status information for each Remote.

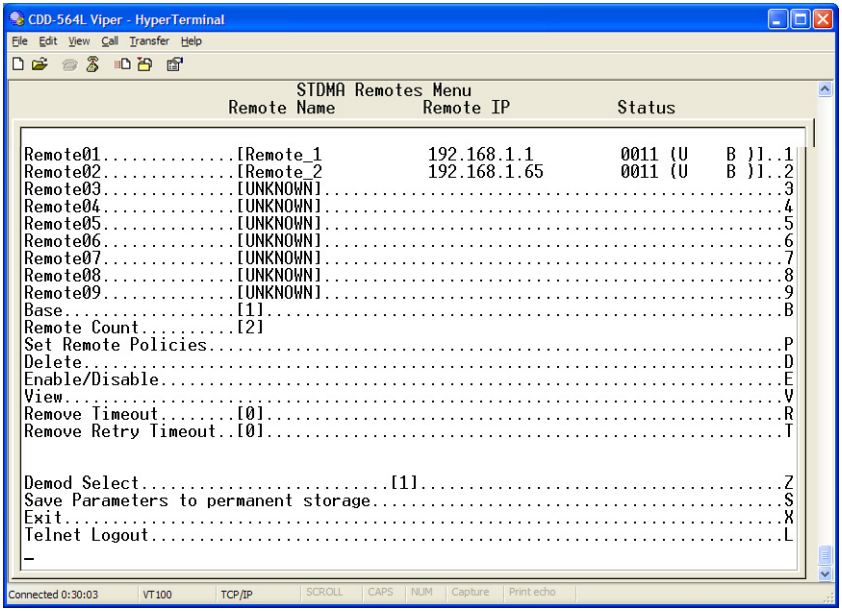


Figure 3-23 STDMA Remotes Menu screen

Adding a Remote to the STDMA Group

Entering the item number for the Remote demodulator/router brings up the dialog shown in figure 3-24. A prompt to enter the **Name** to assign to the Remote unit appears, followed by a prompt to enter the **IP Address** for this unit.

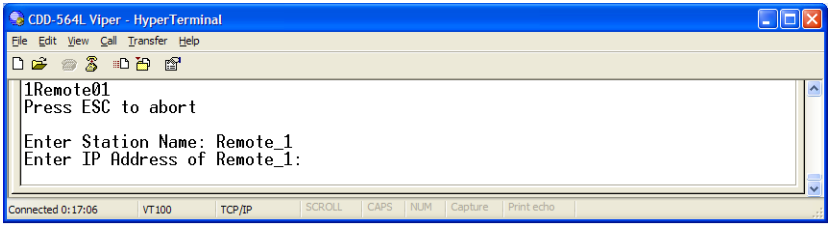


Figure 3-24 Remote Name and IP Address prompt

Once a Remote has been added to the group, its Status in the group is displayed by the use of the following letters:

- **U** = **Used** – This Remote is being used in the burstmap.
  Once a remote has been added to the STDMA group, this status will always be displayed.
- **B** = **Burstmap** – This Remote is currently in the burstmap.
  This status will be displayed unless the remote has been removed (R), disabled (D), or switched (S) out of the STDMA burstmap.

- **R** = **Removed** – This Remote is currently removed from the burstmap. When displayed, this status indicates that the Hub has removed this remote from the burstmap due to a communications fault.
- **D** = **Disabled** – This Remote is currently disabled and is not in the burstmap.
  This status will be displayed when a remote is manually disabled by the operator or administrator.
- **S** = **Switched** – This Remote is currently switched into SCPC mode. When displayed, this status indicates that the VMS has automatically switched the remote out of the burstmap and into SCPC operation.
- **H** = **Home** State Revert – This Remote is not currently receiving burst maps. When a remote, stuck in SCPC mode by failure to receive a VMS revert command, sees the burst map with this flag set, it will automatically revert to its home state and STDMA mode.
- **CF** – This Remote has not sent an acknowledgement to the burst controller since it was enabled.

Most commonly, either a **B** or an **S** will be displayed, as a typical Remote will be either Bursting or Switched out to the *d*SCPC pool.

Base

Entering a **B** at the command prompt in figure 3-23 allows entering the Remote number to start displaying remotes in this menu screen. Entering the number 1, as shown in figure 3-23, displays nine remotes, 1 through 9. If the number 4 had been entered, the display would show the nine remotes starting with Remote 4 (i.e., remotes 4 through 12).

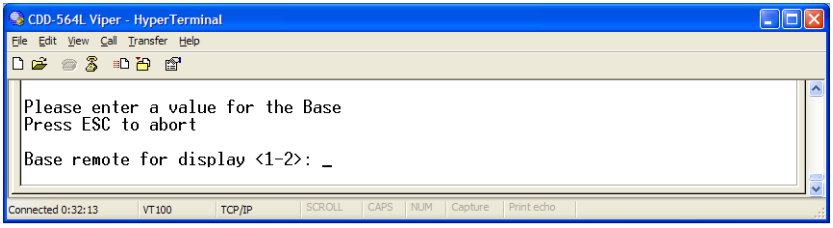


Figure 3-25 Base Remote Display prompt

Remote Count

The **Remote Count** menu item in figure 3-23 is an information-only display showing the total number of Remotes that currently belong to the STDMA group for this Hub burst controller.

Set Remote Policies

This menu item, which appears for *GIR and Entry Channel* Hub types, allows each Remote to be configured for specific data switching conditions.

For Hub STDMA Controllers operating in either GIR or Entry Channel mode, typical load switching *is not* the mechanism that performs the transition from STDMA to SCPC mode due to traffic load. In GIR mode, the Remote is switched to SCPC as soon as the GIR threshold is reached. In Entry Channel mode, the Remote is switched to SCPC as soon as the Hub receives the first transmission from the Remote.

For both GIR and ECM, the event of switching from STDMA to SCPC can only occur if the SCPC Switch Rate parameter is *set to a value greater than 0* (zero). If the switch rate for a Remote is set to 0 kbps, that Remote will remain in STDMA mode and will only switch to SCPC mode due to an application switch or a diagnostic (manual) switch.

Entering **P** at the **STDMA Remotes Menu** command prompt displays the **Remote Policies** screens shown in figure 3-26 (GIR Hub) and figure 3-28 (Entry Channel Hub).

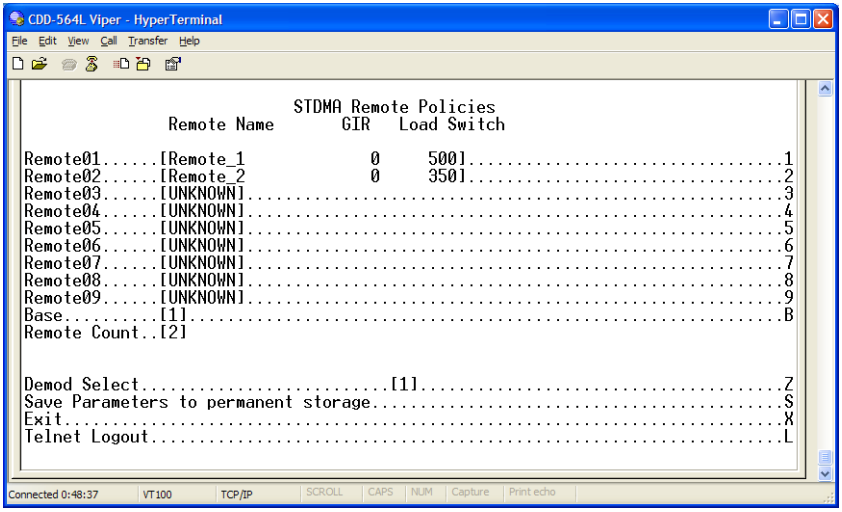


Figure 3-26 STDMA Remote Policies screen (GIR Hub)

Entering the Remote number at the command prompt in figure 3-26 allows the **Guaranteed Information Rate** and the **Automatic Load Switch Rate** for that Remote to be set, as shown in figure 3-27. Note that the Available Bandwidth is displayed for reference in this screen to assist with entering the appropriate rates. The cycle length for GIR is limited to a maximum of one second.

Set the Automatic Load Switch Rate to a value greater than the GIR to allow the Remote to be automatically switched out of STDMA and into SCPC mode when traffic exceeds the GIR. A Switch Rate of **0** will prevent the Remote from being switched out of STDMA and into SCPC mode.

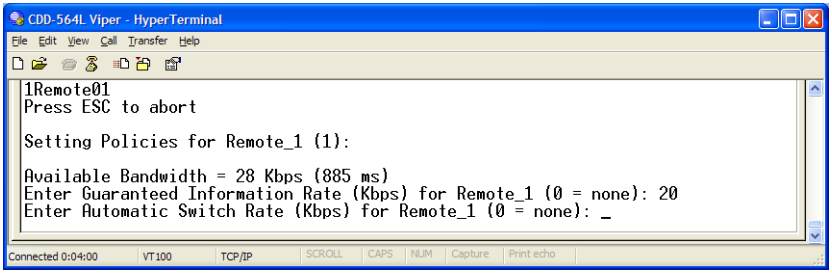


Figure 3-27 GIR Remote Policies prompt

The Remote Policies screen for an Entry Channel Hub type allows the SCPC data rates and switch types to be specified for when the Remotes will switch and the desired starting points for communications.

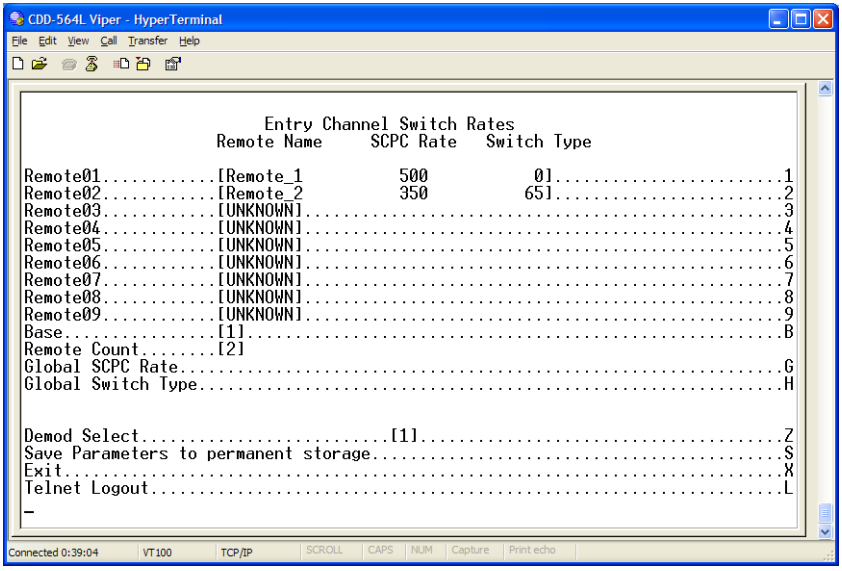


Figure 3-28 Entry Channel Switch Rates screen

Entering the Remote number at the command prompt in figure 3-28 allows the **SCPC Data Rate** and the **Switch Type** for that Remote to be set, as shown in figure 3-29. Switch type **0** corresponds to Load Switching; switch types **64** through **255** are user-defined, and must match VMS policies. When choosing Load Switching as the Switch Type, the associated Remote must have the Load

Switching feature Enabled (see the section "STDMA/SCPC Automatic Switching" on page 3-32).

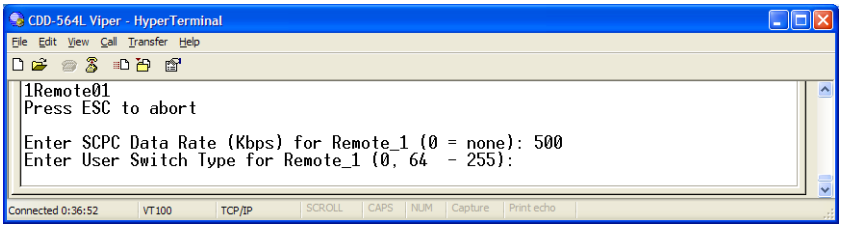


Figure 3-29 Remote SCPC Data Rate prompt

The **Global SCPC Rate** command can be used to set the data rate for all or a majority of the Remotes. This allows the rate to be entered just once instead of entering the rate for each Remote individually. Enter **G** at the command prompt in figure 3-28.

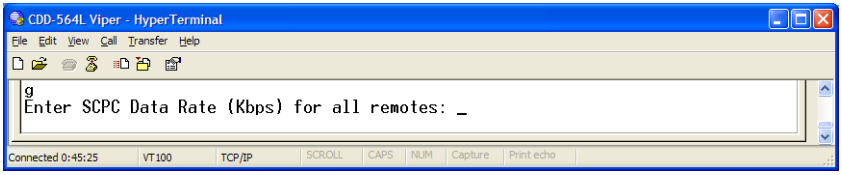


Figure 3-30 Global SCPC Data Rate prompt

Similarly, the **Global Switch Type** command can be used to set the switch type for all or a majority of the Remotes. Enter **H** at the command prompt.

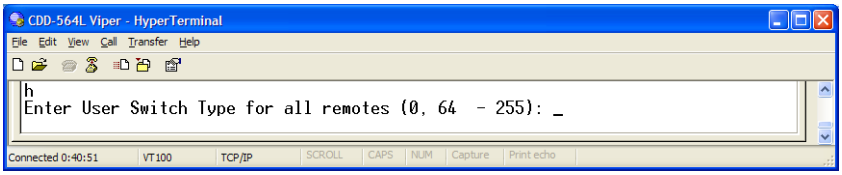


Figure 3-31 Global Switch Type prompt

Delete Remote

Entering **D** at the command prompt shown in figure 3-23 brings up the **Delete Remote** dialog shown in figure 3-32.

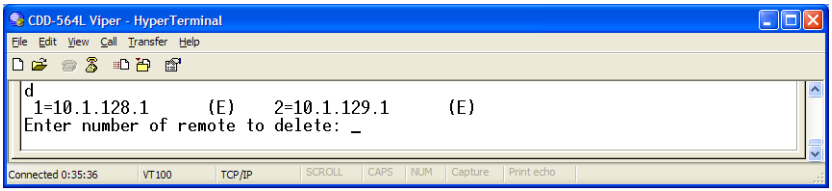


Figure 3-32 Delete Remote prompt

Enter the number of the Remote CDD-56X at the command prompt to delete it from the STDMA group for this Hub burst controller.

Enable/Disable Remote

Enter **E** at the command prompt in figure 3-23 to display the dialog shown in figure 3-33. The Remotes in the network are displayed, indicating whether each is currently **Enabled** (**E**) or **Disabled**.

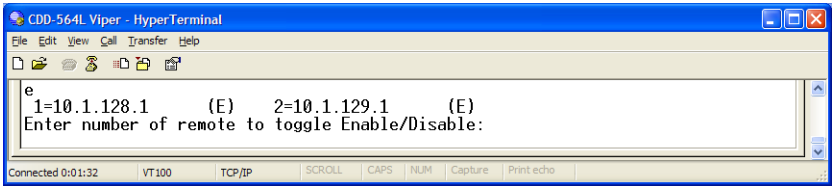


Figure 3-33 Enable/Disable Remote prompt

Enter the number of the Remote at the command prompt to toggle the Remote from its current Enable/Disable configuration.

In the example screen shown above, both Remotes 1 and 2 are Enabled.

View Remote(s)

Entering **V** at the command prompt shown in figure 3-23 will display the listing of Remote(s) that belong to the STDMA group for this Hub burst controller, and their status, as shown in figure 3-34.

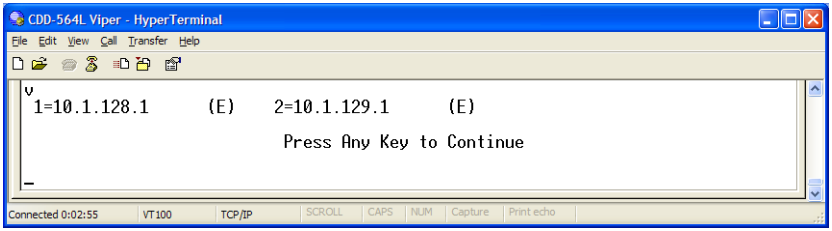


Figure 3-34 View Remote(s) screen

The display is for information only and pressing any key will return the screen to the menu shown in figure 3-23.

Remove Timeout

Entering **R** at the command prompt shown in figure 3-23 will display the **Remove Timeout** dialog shown in figure 3-35. Note that this menu item shows the current setting (in seconds) for this parameter.

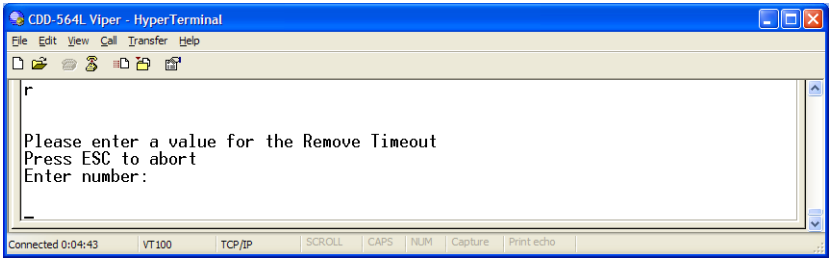


Figure 3-35 Remove Timeout prompt

The value entered at the command prompt defines the amount of time (in seconds) with no communication from a Remote to the Hub before that Remote is removed from the Burst Map. If communications are lost for this specified period of time, the Remote is removed from the STDMA group, and the bandwidth resources it had been allocated are then made available for use by the other remotes remaining in the group.

This feature is useful, for example, in an SNG application where a mobile Remote has finished its assignment and has shut down.

Remove Retry Timeout

Entering **T** at the command prompt in figure 3-23 will display the **Remove Retry Timeout** dialog shown in figure 3-36. Note that this menu item shows the current setting (in seconds) for this parameter.

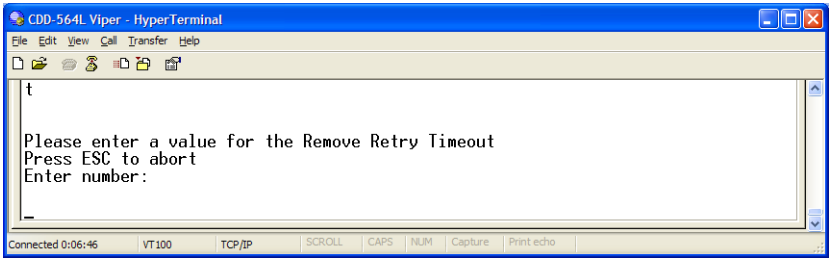


Figure 3-36 Remove Retry Timeout prompt

When a Remote is removed from the group Burst Map, as described in the section “Remove Timeout” above, entering a value in the Remove Retry Timeout dialog defines the amount of time (in seconds) that is allowed to pass before a retry attempt is made to return the removed Remote to the group. The Remote is re-entered into the burst map cycle; if the Remote does not burst back (ACK) to the Hub burst controller, it is again removed from the Burst Map.

This allows, again using a mobile Remote as an example, shutting down the Remote at one location, moving it to a new location, and then automatically re-establishing a connection to the satellite network.

LNB LO Frequency

This menu item appears for an ECMv2 Hub type only.

This parameter, together with the Satellite Frequency Conversion setting, is critical for determining RF frequency translations between Hub and Remote offsets or data spectral inversions. Take care in setting these correctly.

Enter **Z** at the command prompt and specify the correct LNB Local Oscillator frequency (MHz) that this Hub unit will be receiving.

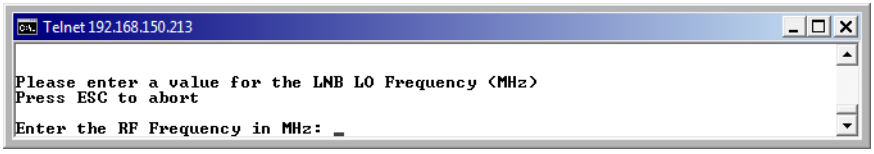


Figure 3-37 LNB LO Frequency prompt

Satellite Frequency Conversion

This menu item appears for the ECMv2 Hub type only.

This parameter, together with the LNB LO Frequency setting, is critical for determining RF frequency translations between Hub and Remote offsets or data spectral inversions. Take care in setting these correctly.

Enter **F** at the command prompt and specify the correct Satellite Frequency Conversion value (MHz) that this Hub unit requires.

Figure 3-38 Satellite Frequency Conversion prompt

STDMA Statistics

Entering **V** at the command prompt in the **STDMA** screen displays the **STDMA Statistics** screen as shown in either figure 3-39 (Hub) or figure 3-40 (Remote).

Note that statistics will only be accumulated for a CDD-56X that is configured as a Hub with No Expansion, since that is the only configuration that provides STDMA functionality (on Demod 1). Because a Remote unit is SCPC mode only, the STDMA Statistics screen will display all values as 0.

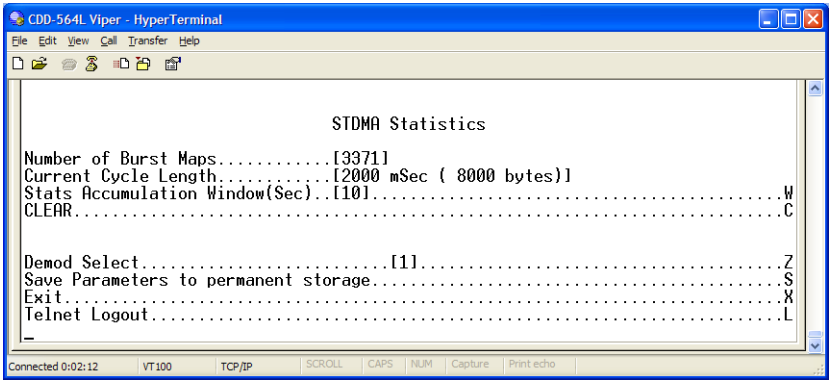


Figure 3-39 STDMA Statistics screen (Hub)

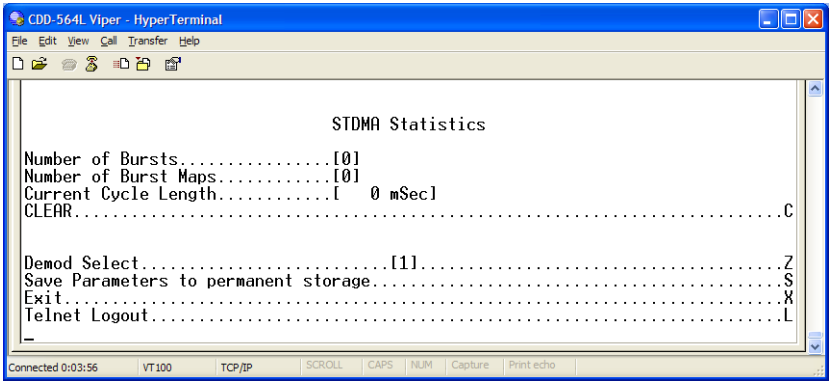


Figure 3-40 STDMA Statistics screen (Remote)

Stats Accumulation Window

Entering **W** at the command prompt displays the **Stats Accumulation Window** as shown in figure 3-41. The time period, in seconds, for capturing STDMA statistics can be specified.

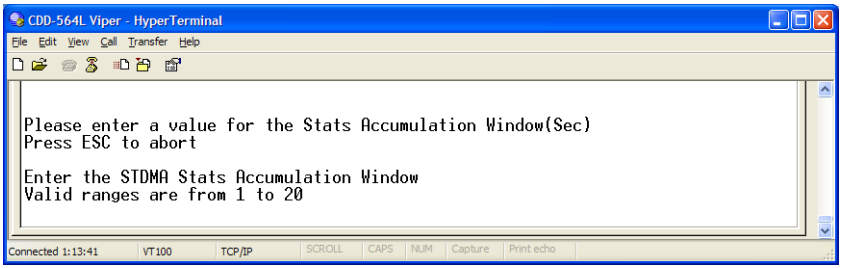


Figure 3-41 Stats Accumulation Window prompt

Clear

The STDMA statistics can be **Clear**ed (reset) by entering a **C** at the command prompt in figure 3-39.

Show Hub Statistics

Entering a **W** at the command prompt in the **STDMA** screen displays the current statistics for the target CDD-56X Hub as shown in figure 3-42.

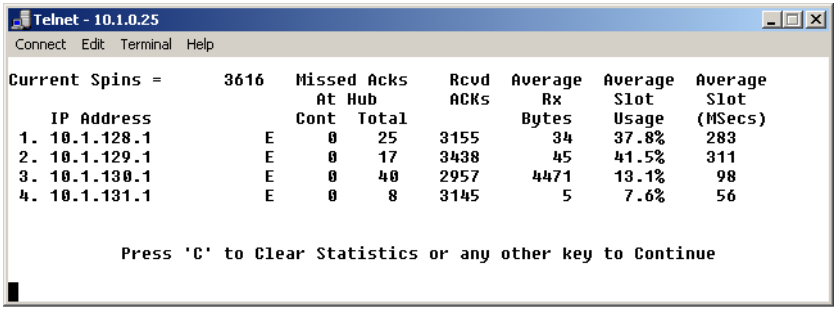


Figure 3-42 Show Hub Statistics screen

Statistics in the received ACK from each Remote are monitored by the Burst Controller. These statistics report the fill status of the burst data slot for each Remote. The Burst Controller builds a table of the group and calculates the relative data byte count for each Remote. It then calculates the length of the Data Slot for each Remote based on the Minimum Slot Length plus a percentage of the Available Bandwidth. Idle Remotes receive a data slot equal to the Minimum Slot Length.

In figure 3-42, Remote 1 with IP address 10.1.128.1 had activity during the averaging period. It captured 37.8% of the total slot time and had an average slot length of 283 ms. Remotes 2, 3, and 4 had 41.5%, 18.1% and 7.6% respectively. The dynamic range of STDMA is a function of the difference between the Nominal Data Length and the Minimum Data Length parameters. These

parameters are operator selectable. The speed with which STDMA reacts to changes in dynamic load is a function of the Statistics Accumulation Window parameter and the Cycles per New Burst Map parameter, both of which are also operator selectable.

The Hub statistics are useful for tuning the Burst Controller. Preamble adjustments, up or down, are made using the missed ACKs statistic; a preamble and/or guardband that is too short will result in an accumulation of missed ACKs. The "Cont" column represents continuous—the number of sequential ACKs missed.

An informative indicator in the Hub Statistics screen is the STDMA status of the Remotes that appears in the first column to the right of the IP Address list. The Remote status is displayed in one of three possible modes:

- **E** – Remote is **E**nabled and active in the STDMA group; the Hub burst controller is receiving ACKs from this Remote.
- **ER** – Remote is **E**nabled but has been **R**emoved from the STDMA group due to missed ACKs at the Hub burst controller.
- (Blank) – Remote either has been manually Disabled, such as through the STDMA Remotes Menu Enable/Disable command, or has been switched out of STDMA to SCPC mode by the VMS.

STDMA/SCPC Automatic Switching

One of the most powerful features of the Vipersat Network system is the capability to perform Automatic switching between STDMA mode and SCPC mode based on bandwidth demand. The configuration options that are available to meet customer-specific requirements are extensive, and include switching based on Load, Application (Voice and Video RTP), ToS, and QoS.

For additional information, refer to Appendix B, "Automatic Switching", in this document.

Note: Care must be taken when configuring the Auto Switching features of the Vipersat system to ensure that there is no duplication or overlap of switching functions between Application, ToS, and QoS for a particular traffic flow. Only one of these switching methods should be utilized for any one flow requirement.

Automatic Switching for the CDD-56X is an option that is available only when configured as an STDMA Hub unit (burst controller). Note that Automatic switching does not apply to either a *Hub Expansion* unit or a *Remote Expansion* unit; these Vipersat working modes operate in dedicated SCPC mode and all

switching control is performed by the VMS. As is shown in table 2-2, Auto Switching should be Disabled for these two modes.

The **Auto Switching** feature must be Enabled (as described in the section "Feature Configuration" on page 3-5) in order to allow any associated Remote modems to perform STDMA/SCPC switching. In order for a Remote modem in the group to be automatically switched between STDMA and SCPC modes, the Auto Switching feature of that Remote must be Enabled as well.

Selecting **Automatic Switching** from the **Vipersat Configuration** menu shown in figure 3-6 (enter **A**) for a CDD-56X operating as a network Hub will display the menu shown in figure 3-43.

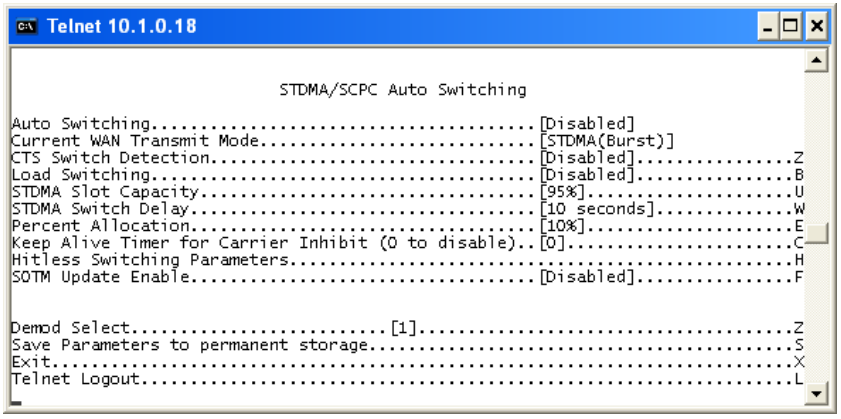


Figure 3-43 Automatic Switching screen

The following sections describe the menu items of the **STDMA/SCPC Auto Switching** screen shown in figure 3-43.

Auto Switching

The **Auto Switching** item on the menu shown in figure 3-43 is for information only and shows the current configuration of the Hub CDD-56X. This feature is Enabled and Disabled as described in the section "Feature Configuration" on page 3-5. Auto Switching must be **Enabled** in order to utilize any of the related features/commands in this menu.

Note that Auto Switching must be Enabled on a Hub STDMA Controller that is configured for either Entry Channel or ECMv2 mode.

Current WAN Transmit Mode

The **Current WAN Transmit Mode** item on the menu in figure 3-43 is information only and reflects the current transmit status of a unit. In the case of the CDD-56X, there is no transmit function (no modulator) and this parameter is not applicable.

Load Switching

The **Load Switching** command on the menu in figure 3-43 is a toggle Enabling and Disabling Load Switching on the target Hub CDD-56X. The system will detect variations in data rate and can be configured to switch from STDMA to SCPC based on bandwidth requirements.

The initial switch for a Remote Vipersat terminal from STDMA mode to SCPC mode is determined by the Hub Burst Controller. Once the Remote is switched into SCPC, any requests to meet additional switching requirements within SCPC (Step Up or Step Down) are made by the Remote modem.

Entering a **B** at the command prompt will toggle this feature On or Off for the target CDD-56X.

NOTE

Note: Load switching must be Enabled for any Hub CDD-56X burst controller that will experience changing load conditions in order for the VMS to dynamically optimize network performance on these circuits.

Application switching by the VMS (Voice and/or Video) is not affected by this setting. However, using Load switching for real-time applications is not recommended.

STDMA Slot Capacity

The **STDMA Slot Capacity** command, shown in figure 3-43, allows setting the threshold or level of slot capacity at which the Burst Controller sends a switch request to the VMS to switch the Remote from STDMA mode to SCPC mode.

Enter **U** at the command prompt to display the dialog shown in figure 3-44.

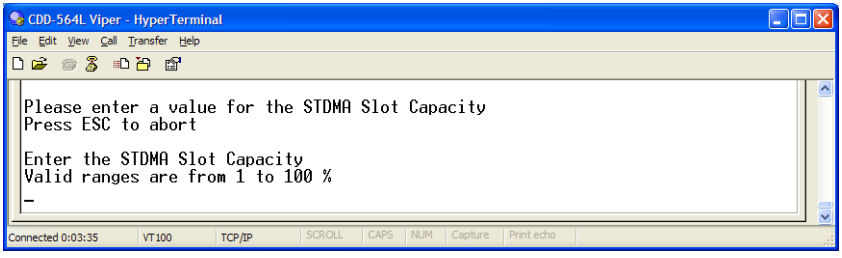


Figure 3-44 STDMA Slot Capacity prompt

A default setting (95%) is provided, but there may be unique network configurations which require modifying the STDMA Slot Capacity value.

STDMA Switch Delay

In order to minimize unnecessary switching from STDMA to SCPC due to transient conditions, such as a temporary spike in network traffic for example, a switch delay parameter is provided. This setting is used to specify a delay before a switch occurs.

A default value (10 seconds) is provided, but this value can be changed to accommodate a unique network configuration or application. To change this setting, enter **W** at the command prompt in figure 3-43 to display the screen shown in figure 3-45.

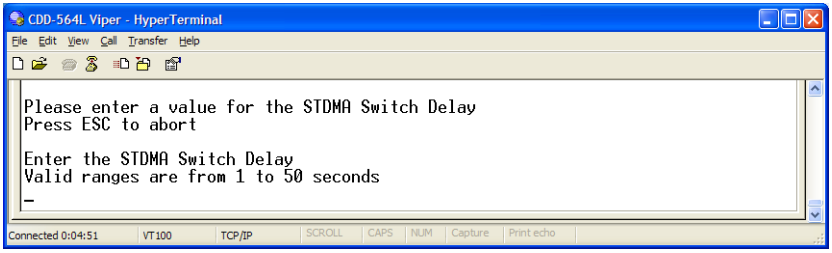


Figure 3-45 STDMA Switch Delay prompt

Percent Allocation

The **Percent Allocation** menu item, shown in figure 3-43, allows adding a fixed percentage to the channel bandwidth request to accommodate additional bandwidth requirements which may occur after a switch is made from STDMA to SCPC mode.

To change this setting, enter **E** at the command prompt to display the screen shown in figure 3-46.

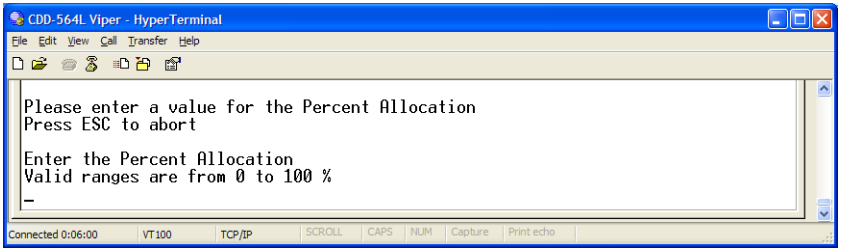


Figure 3-46 Percent Allocation prompt

Typically the default value will be optimum, but if there may be a larger bandwidth requirement after the switch, the percent allocation value can be increased. In choosing a value for this allocation, future bandwidth requirements for the channel must be balanced against efficient bandwidth utilization.

Keep Alive Timer for Carrier Inhibit

This parameter applies to a **Hub** unit only. Note that, although this menu item also appears for a Remote unit, it does not apply to a switched demod unit at a remote site.

The **Keep Alive Timer for Carrier Inhibit** parameter provides a fixed setting that can be specified for the keep alive message sent to the Remotes from the Hub. This provides an alternate to the burst map which is variable and may become excessively long in certain applications. An example of this is a burst map containing a large number (up to 100) of remotes running in ECM mode where the burst period exceeds the Remote carrier inhibit timer.

When implemented, this parameter is set at either the TDM outbound unit or a switched demod, not at the STDMA Controller, in order to prevent a problem should the burst controller be rebooted.

Enter **C** at the command prompt in the **Auto Switching** screen to display the dialog shown in figure 3-47.

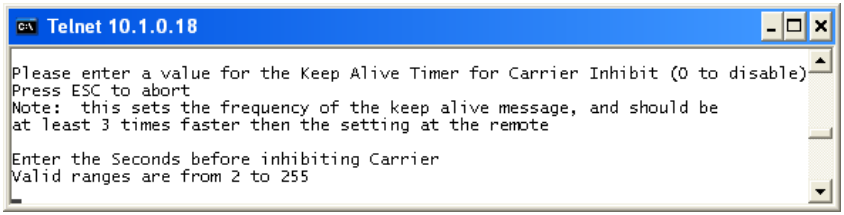


Figure 3-47 Keep Alive Timer for Carrier Inhibit prompt

Note that this timer setting should be at least three times faster (shorter in duration) than the timer setting at the Remote(s) to ensure that network links are maintained.

Hitless Switching Parameters

Unless inherent delays in configuring both ends of a satellite bandwidth link during dynamic switching are accounted for, transmitted data may be lost during the transition. The time for a switch command to be sent across the satellite link (~ 250 ms), the command processing time, as well as receiver acquisition time must be considered. The Vipersat **Hitless Switching** feature provides

a means to coordinate timing and utilize buffering to eliminate these data outages.

To access the Hitless Switching screen, enter **H** from the STDMA/SCPC Auto Switching screen (see figure 3-43).

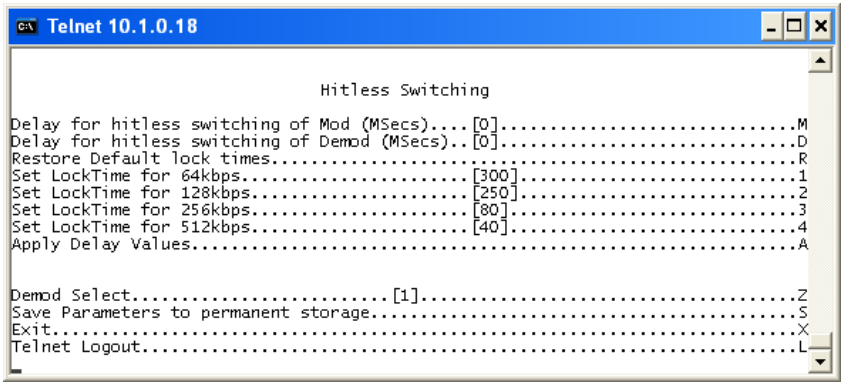


Figure 3-48 Hitless Switching screen

This screen will initially display all lock times as -1, indicating that Hitless Switching is currently disabled. To enable the Hitless Switching feature, enter **R** at the command prompt to restore default lock times.

Delay for Mod

This parameter allows the operator to insert additional delay to buffer more data after modulator transmission is ceased. Enter **M** to modify this parameter.

Delay for Demod

This parameter allows the operator to insert additional delay to account for the tuning of the demodulator. Enter **D** to modify this parameter.

LockTimes

LockTime settings for the four data rates displayed can be adjusted either up or down, but default settings based on satellite testing should be used as a starting point. These defaults are stored in each modulator/demodulator unit and are restored by entering **R** at the command prompt.

Once restored, the lock time for each data rate can be modified by entering the corresponding number.

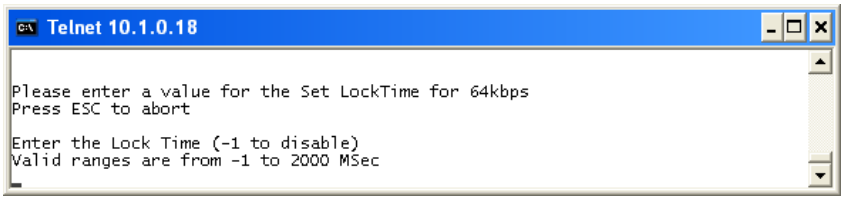


Figure 3-49 Set LockTime prompt

To disable Hitless Switching, enter **-1** for all lock times.

Apply Delay Values

To implement any modifications to the Hitless Switching parameters, enter **A** at the command prompt to apply these values to the modem.

SOTM Update

This menu item appears for both the Hub unit and the Remote unit. However, this feature is not applicable to the CDD-56X.

Unit Role

The **Unit Role** configuration determines whether the target CDD-56X is to function as a **Remote** or as a **Hub** in the Vipersat satellite network. From the **Vipersat Configuration** screen (figure 3-6), enter **R** to display the dialog shown in figure 3-50.

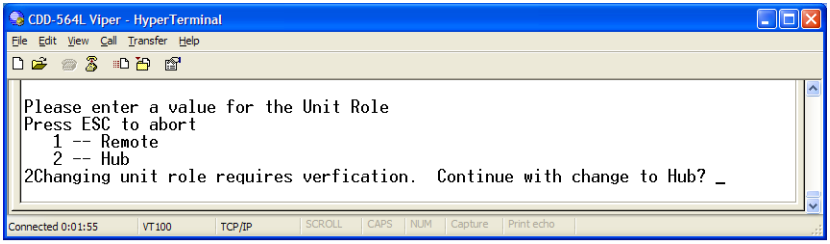


Figure 3-50 Unit Role prompt

The setting for this parameter, together with the setting for the Expansion Unit, will determine the role the target CDD-56X will perform in the network and what type of commands and functions it will receive from the VMS. See table 2-1 and table 2-2 for a breakdown of network roles and related functions and features.

Expansion Unit

The **Expansion Unit** menu item in the **Vipersat Configuration** screen (figure 3-6) defines whether the target CDD-56X is to function as an Expansion unit (all demods configured to operate in SCPC mode) or not. Entering **E** at the command prompt will display the dialog shown in figure 3-51.

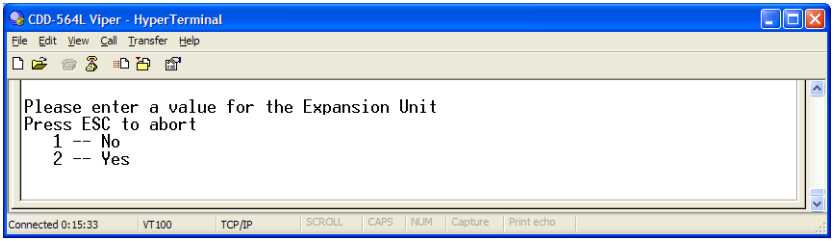


Figure 3-51 Expansion Unit prompt

The VMS uses this data when monitoring and controlling the network to determine the target CDD-56X's function. For example, in a Hub configuration that has STDMA enabled for the first demod, Expansion Unit should be set to **No**.

When configured as an Expansion unit, either as a Hub (switched) or as a Remote (mesh), the CDD-56X is set up so that all demods are in SCPC mode and available as resources for dedicated communications with the other end of the satellite link.

For a Remote configuration, this parameter must be set to Yes. For a Hub configuration, this parameter can be set to either No or Yes. Refer to table 2-1 and table 2-2 for a breakdown of network roles and related functions and features.

NOTE

Note: Setting Vipersat STDMA to Disabled alone will not force the demods into an SCPC role—the Expansion Unit parameter must be set to Yes for this function. Likewise, Expansion Unit must be set to No together with STDMA Enabled for proper STDMA function.

Network ID

The **Network ID** that is assigned to the unit defines to what network the target CDD-56X will belong. All units used in a network will have the same Network ID. Enter **B** at the command prompt in the **Vipersat Configuration** screen (figure 3-6) to display the dialog shown in figure 3-52.

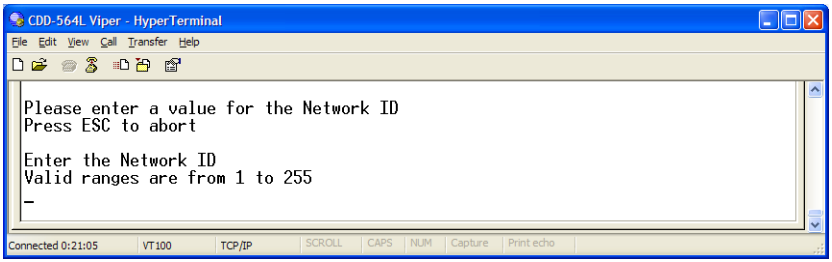


Figure 3-52 Network ID prompt

The Network ID is used by the VMS to identify units that are common to a network and allows the VMS to manage multiple networks, each with its own unique Network ID number.

Unit Name

The **Unit Name** command in the **Vipersat Configuration** screen (figure 3-6) is used to assign a name to the target CDD-56X. Enter **N** at the command prompt to display the dialog shown in figure 3-53 . Any name, up to 16 characters, can be entered for the unit.

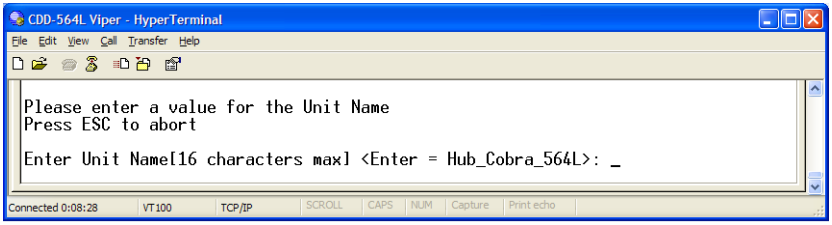


Figure 3-53 Unit Name prompt

This name is displayed by the VMS and identifies the unit in Network Manager, the graphical network display.

Receive Multicast Address

The **Receive Multicast Address** is the multitcast IP address assigned to all CDD-56X units in the Vipersat network that are managed by the VMS server. This address must match the VMS Transmit Multicast Address.

When the CDD-56X receives a multicast from the VMS server, it receives maintenance and control packets, including the server's IP address. The

CDD-56X responds to the VMS server with a unicast containing its current configuration data, including the CDD-56X's IP address. When the VMS receives the unicast response, it registers the CDD-56X on the network.

Enter **V** at the command prompt in the **Vipersat Configuration** screen (figure 3-6) to display the dialog shown in figure 3-54. Enter the Receive Multicast Address as assigned by the network operator/administrator.

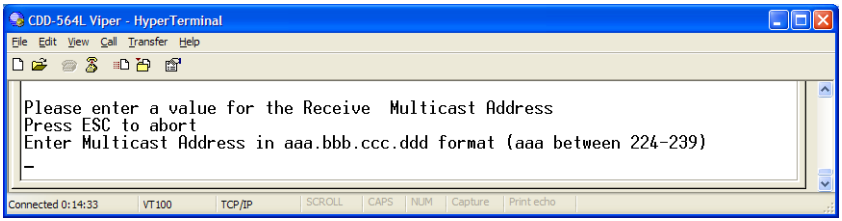


Figure 3-54 Receive Multicast IP Address prompt

Managing IP Address

The **Managing IP Address** command in the **Vipersat Configuration** screen (figure 3-6) allows the IP address for the server running VMS to be entered. Enter **I** at the command prompt to display the dialog shown in figure 3-55.

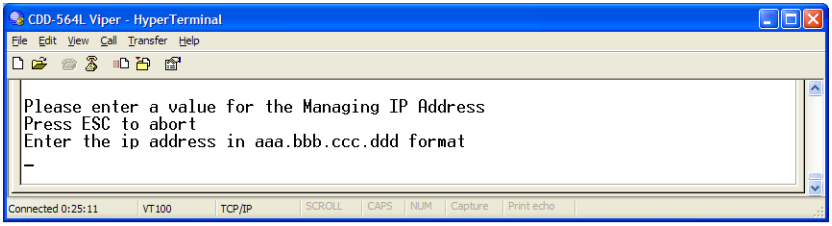


Figure 3-55 Managing IP Address prompt

The Managing IP Address of the VMS is sent out with the multicast to all of the Vipersat units and will be automatically updated during the registration process. The CDD-56X sends a unicast registration request to the managing address every 60 seconds when requesting initial registration on the VMS network. Later the CDD-56X uses this address to send switch requests, network health status messages, etc. to the managing VMS server.

NOTE

Note: The managing address will be set automatically if the Receive Multicast Address is configured correctly and the unit is receiving the announcement multicast message. However, the unit WILL NOT send its registration request message until this address is set.

Once the unit is registered, the **I** command is removed from the Vipersat Configuration menu.

This managing address is automatically updated on a periodic basis for units that are newly enabled, incorrectly set, or following VMS changeovers (redundancy switching). The status of the registration process is displayed for this parameter as follows:

- **NOT-DEFINED** — unit has booted up, but is unaware of the managing address.
- **No STDMA Xmit Grant** — operator has entered managing address, but unit (Remote) is not currently receiving burst maps.
- **Sending Registration (n)** — unit is receiving burst maps and the number of registration attempts (n) is displayed.
- **Registered** — unit is registered with the VMS. For VMS v3.6.0 and later, the VMS version number is also displayed (as shown in figure 3-6).

Management Security

Management Security is an optional Vipersat feature that provides encryption on all VMS management messages passed between the VMS and the network modems. When enabled, the VMS and all of the network modems must utilize a common Encryption Key that is manually set on each. The key can be entered either as an ASCII hex string of exactly 64 characters, or as a passphrase consisting of 5 to 63 characters.

For modems that operate with Management Security, *Enable* this feature and enter the Encryption Key that has been defined for the network.

Note: VMS version 3.7.1 or greater is required for Management Security.

Caution: During the process of network-wide key distribution and enabling of encryption, communications may be lost as the STDMA control messages will be unreadable until all modems in the network are configured.

It is recommended that each of the Remote units be configured for Management Security first, and then the Hub units be configured. This method will reduce the need for on-site personnel during feature implementation.

If the FAST feature key for Management Security has been purchased for the target modem, then it will appear as a menu item on the *Vipersat Configuration* screen (figure 3-6).

Enter **K** at the command prompt to configure this feature, as shown in figure 3-56, below.

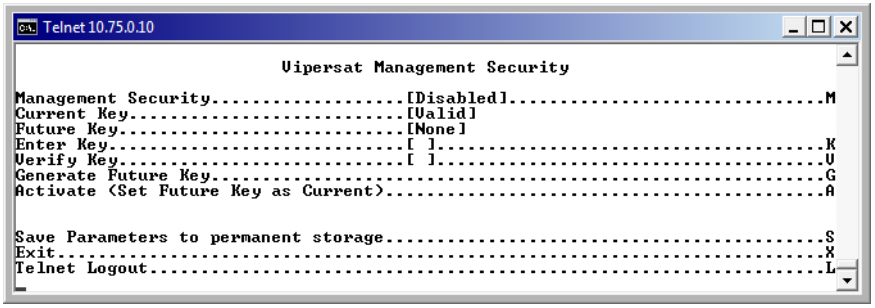


Figure 3-56 Vipersat Management Security screen

Enter **M** at the command prompt to toggle between Enabled/Disabled. Note that the feature must be set to **Enabled** in order to configure the encryption key.

Enter **K** at the command prompt and **Enter** the required key (figure 3-57). (Following entry, the characters will be temporarily displayed in the menu for reference pruposes.)

Figure 3-57 Encryption Key Entry prompt

Enter **V** at the command prompt and re-enter the same key to **Verify** it. (Following entry, the characters will be temporarily displayed in the menu for reference purposes.)

Enter **G** at the command prompt to execute the verfication process and **Generate** the hex key.
The *Future Key* menu item will display **Valid** to indicate successful verification of the key and that it is ready for activation.

Enter **A** at the command prompt to **Activate** the key for current use.
The *Current Key* menu item will display **Valid** to indicate successful activation.

Primary Heart Beat

This menu item appears for the Hub terminal only.

The **Primary Heart Beat** feature is a redundancy heart beat message for primary Hub units that provides the option for a periodic communications check message to be sent from the Hub modem to the VMS for backup recovery in N:M redundancy (protected) configurations. The message interval is hard-coded in the demod.

Enter **P** at the command prompt in the **Vipersat Configuration** screen (figure 3-6) to toggle this feature between **Enabled** and **Disabled**.

Home State Revert

This menu item appears for the Remote terminal only.

The **Home State Revert** feature allows automatic resource recovery to be performed on SCPC connections when a communications failure occurs between the VMS and a Remote, such as a rain fade condition, a Remote unit power down, or a hardware failure. The period of time (in minutes) for a failure is configured in the VMS for each Remote in the network. Should communications be lost for more than the specified time period, the Remote will automatically revert to its Home State settings and the VMS will remove all allocated resources (bandwidth, demod(s)), freeing them for use by any other Remote in the Vipersat network.

Because this feature is configured in the VMS, the status (Disabled, or the time period in minutes) appears as an information-only display in the **Vipersat Configuration** menu (figure 3-6).

Dynamic Power Control Configuration

Dynamic Power Control (DPC) is a Vipersat feature that acts to regulate the transmit power of the Vipersat satellite modem, such that the specified receive signal level (E_b/N_o) is met for the receiving Vipersat units in the group. DPC is driven by the receiver demod, which notifies the transmitting modem of the current E_b/N_o value.

Refer to Appendix C, “Dynamic Power Control”, in this document for additional information on the DPC feature.

The **Dynamic Power Control Configuration** screen (enter **C** in the Vipersat Configuration menu) allows for setting the parameters for the CDD-56X power

levels. The information and commands in the menu will vary depending on the function the target CDD-56X performs in the network. The screen shown in figure 3-58 is from a unit serving as a Hub with STDMA (burst controller). Note, however, that the only parameter settings that apply to the CDD-56X are **DPC Enabled**, **Speed Up EbNo**, and **Target DPC Address**. Because all of the remaining settings shown in this screen are redundant to those configured in the satellite modem (CDM-570), they do not apply to the CDD-56X and can be disregarded.

For comparison, the DPC Configuration screen for a unit operating as a Hub or Remote with Expansion (SCPC mode) is shown in figure 3-59. Note that only the applicable settings appear in this screen.

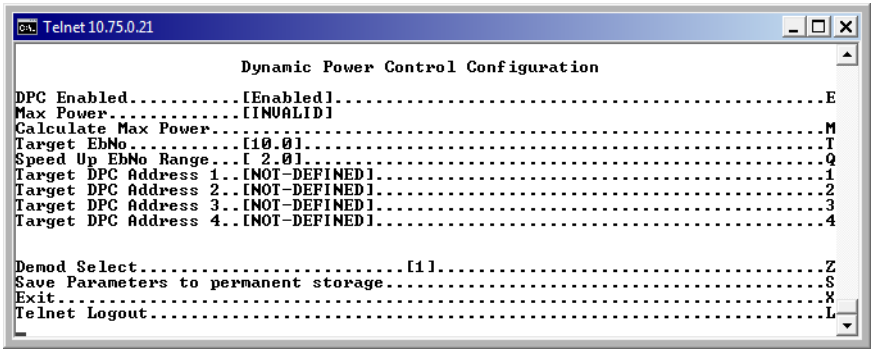


Figure 3-58 DPC Configuration screen (Hub, STDMA)

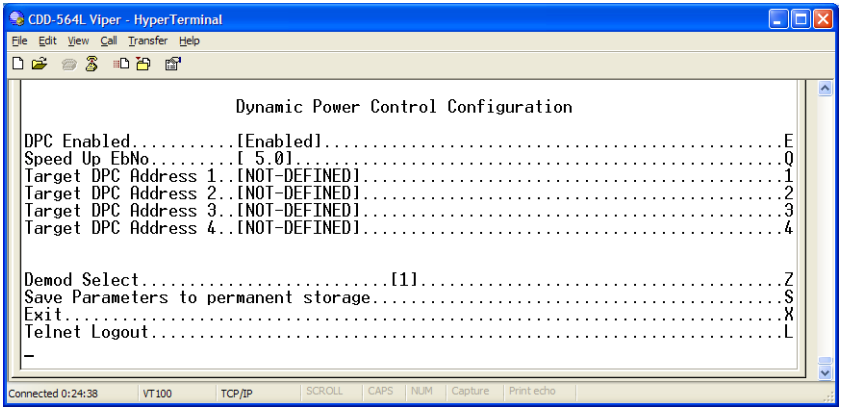


Figure 3-59 DPC Configuration screen (Hub/Remote, SCPC)

Tip: The DPC feature will not function unless the Outbound IP address is defined in the STDMA screen for the Hub BC modem.

DPC Enabled

The **DPC Enabled** command (enter **E**) is a toggle that allows the Dynamic Power Control feature to be either **Enabled** or **Disabled**. The CDD-56X is shipped with the DPC Enabled menu item turned off (Disabled) to allow entrance link levels calibration during terminal setup.

Speed Up EbNo

Normally, the DPC message is sent every 60 seconds from each terminal in the network. If the current E_b/N_o value of the terminal drops below the **Speed Up EbNo** set value, the corresponding terminal increases its message send rate to every 15 seconds until the current value becomes greater than the set value. This provides a loop speed up to rapidly regain link quality.

Enter **Q** at the command prompt in the DPC Configuration screen to access the Speed Up EbNo dialog shown in figure 3-60. The default value for this parameter is 5 dB.

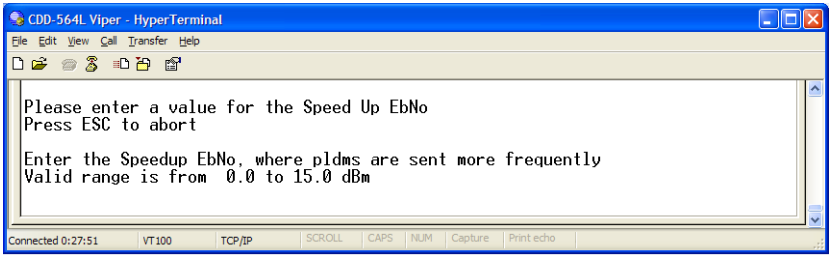


Figure 3-60 Speed Up EbNo prompt

Target DPC Address

The **Target DPC Address** identifies the modem that is transmitting to this CDD-56X Demod, and will be receiving the DPC messages that provide the current E_b/N_o value for this Demod. Typically, all Remotes will specify the Hub modem that is supplying the TDM outbound carrier.

For STDMA Remotes, the Outbound IP address is sent out via the Burst Map, and the DPC Target for these Remotes is automatically mapped to that address.

The Target DPC Address command is used only for units that are Out-of-Band and will be utilizing the DPC feature. For In-Band units, the target addresses are handled automatically by the VMS.

To manually configure the target address for an Out-of-Band unit, enter the number corresponding to the appropriate Demod (1, 2, 3, or 4) at the command prompt to display the Target DPC Address dialog shown in figure 3-61.

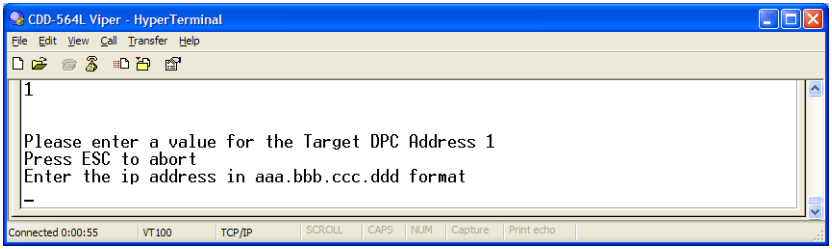


Figure 3-61 Target DPC Address prompt

The STDMA Burst Controller (Demod 1 on a CDD-56X configured as Hub with No Expansion) is not permitted to specify a DPC Target because the demodulator is receiving multiple bursts very rapidly from all Remotes in the group and is unable to utilize DPC to control the transmit power of the Remote modems. However, the transmit power of the Burst Controller adjusts to meet the target E_b/N_o values for the Remotes in the group. These Remotes and their status and E_b/N_o values are displayed in the Vipersat Summary screen, DPC details (see “Vipersat Summary” on page 3-51).

Set Home State Parameters

A CDD-56X’s **Home State** consists of those parameters which provide a known RF configuration that the CDD-56X will return to, either as the result of a command by the VMS, or as it comes back on line from a reset or a power cycle.

Enter **H** at the command prompt in the **Vipersat Configuration** screen to display the **Home State Configuration** screen shown in figure 3-62.

A CDD-56X’s Home State settings are typically selected so that it goes to a configuration which is optimum for its function in the network. These parameters are configured on an individual, per demod basis.

Note that each of these Receive parameters are the same as found in the **Rx Configuration** screen that is in the **Satellite Demod Configuration** menu.

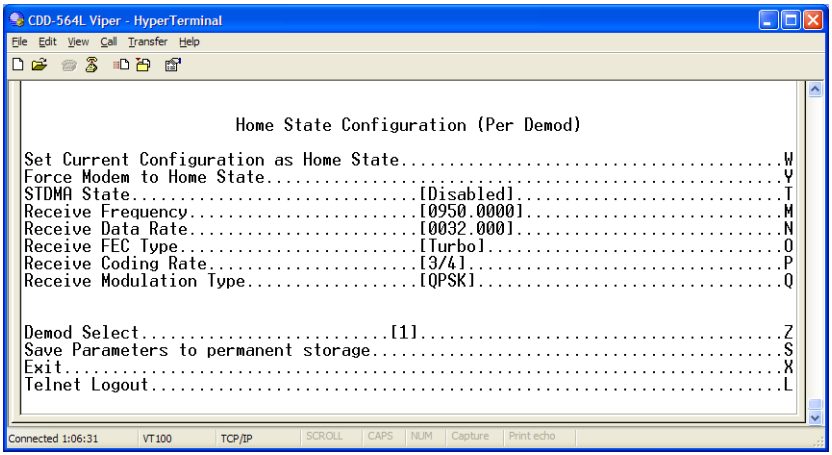


Figure 3-62 Home State Configuration screen

Set Current Configuration as Home State

This command sets the selected Demod's current configuration as its Home State settings. Assuming the Demod has been properly configured using the **Satellite Demodulator Configuration** menu (Rx parameters) and the **Feature Configuration** menu (Vipersat STDMA setting), these parameter values will be copied into the Home State configuration. Rather than entering each of these values individually, this command can be used as a shortcut for establishing the Home State settings.

Enter **W** at the command prompt in the **Home State Configuration** screen to execute this command. Once saved, the modem will be configured with the Home State settings at boot time and when manually reset with the **Force Modem to Home State** command.

Tip: This command is useful when a CDD-56X's initial set up is completed and the unit is functioning as desired in a network.

Force Modem to Home State

If at any time it is desired to have a CDD-56X return to its Home State, this command (enter **Y**) can be executed. A warning message is displayed as shown in figure 3-63, requiring the command to be confirmed before it is executed.

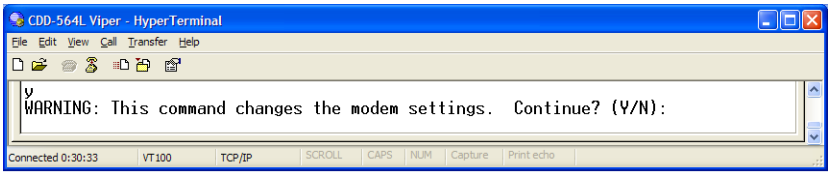


Figure 3-63 Force Modem to Home State warning

This command will force the selected Demod to its Home State configuration, replacing its current configuration.

STDMA State

This command (enter **T**) toggles the setting of STDMA in the target CDD-56X's Home State between **Enabled** and **Disabled**. This is the same feature that is set from the **Feature Configuration** menu screen shown in figure 3-4. Setting the STDMA State to Enabled is only applicable for a CDD-56X that is configured as a Hub burst controller.

NOTE

Note: Only one demod can be set with STDMA enabled. Vipersat recommends that Demod 1 be utilized for applications calling for STDMA.

Receive Frequency

Enter **M** to use the dialog shown in figure 3-64 to set the **Receive Frequency** for the selected Demod's Home State.

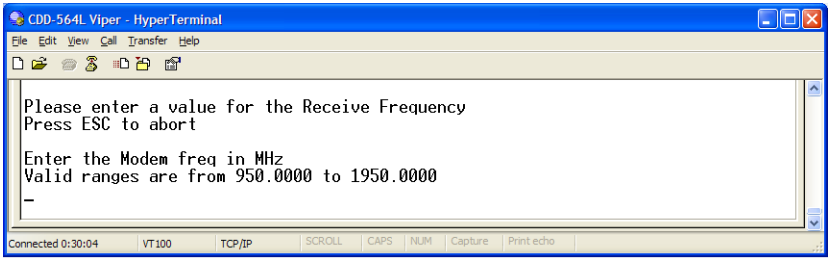


Figure 3-64 Receive Frequency prompt

Note that this screen dialog example displays the frequency range for a CDD-562L/564L L-Band Demodulator/Router. For a CDD-564, the range displayed will be either 50 to 90 MHz or 100 to 180 MHz.

Receive Data Rate

Enter **N** to use the dialog shown in figure 3-65 to set the **Receive Data Rate** for the selected Demod's Home State.

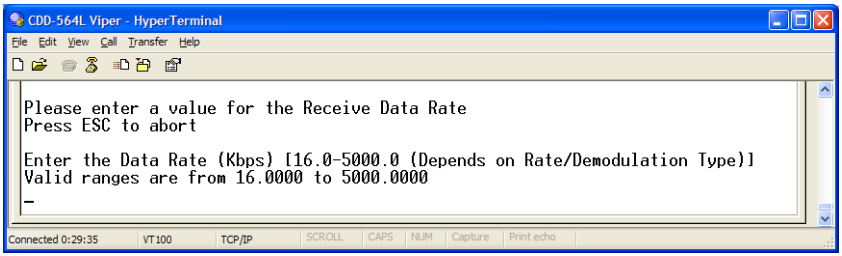


Figure 3-65 Receive Data Rate prompt

Note that the valid range for this parameter will vary depending on the Demodulation Type, Coding Rate, and FAST feature Data Rate.

Receive FEC Type

Enter **O** to use the dialog shown in figure 3-66 to set the **Receive FEC Type** for the selected Demod's Home State. **Turbo** must be selected when operating in Vipersat mode.

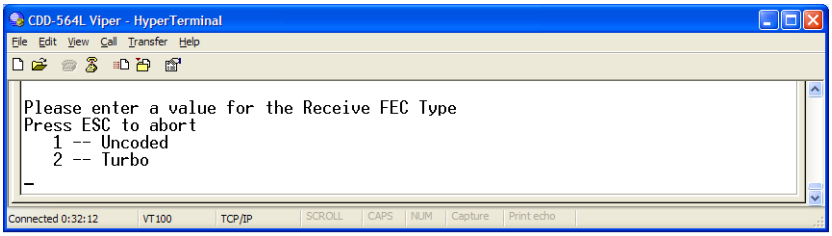


Figure 3-66 Receive FEC Type prompt

Receive Coding Rate

Enter **P** to use the dialog shown in figure 3-67 to set the **Receive Coding Rate** for the selected Demod's Home State.

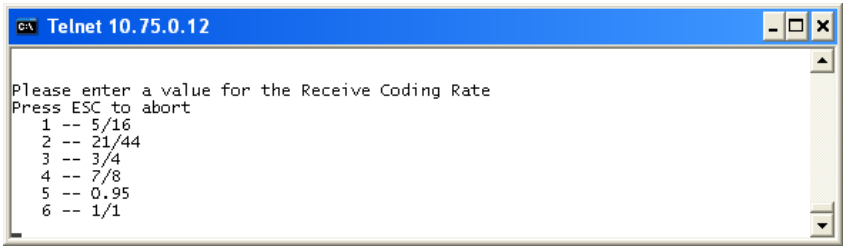


Figure 3-67 Receive Coding Rate prompt

Note that Coding Rate **6** (1/1) is not a valid selection when operating in Vipersat mode with Turbo Product Coding.

Receive Modulation Type

Enter **Q** to use the dialog shown in figure 3-68 to set the **Receive Modulation Type** for the selected Demod's Home State.

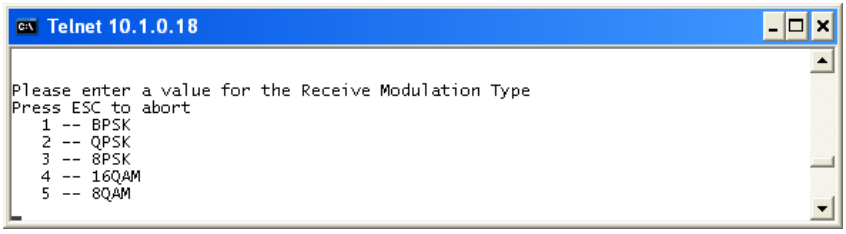


Figure 3-68 Receive Modulation Type prompt

Vipersat Summary

The **Vipersat Summary** screen can be viewed by entering **D** at the command prompt in the **Vipersat Configuration** screen (figure 3-6).

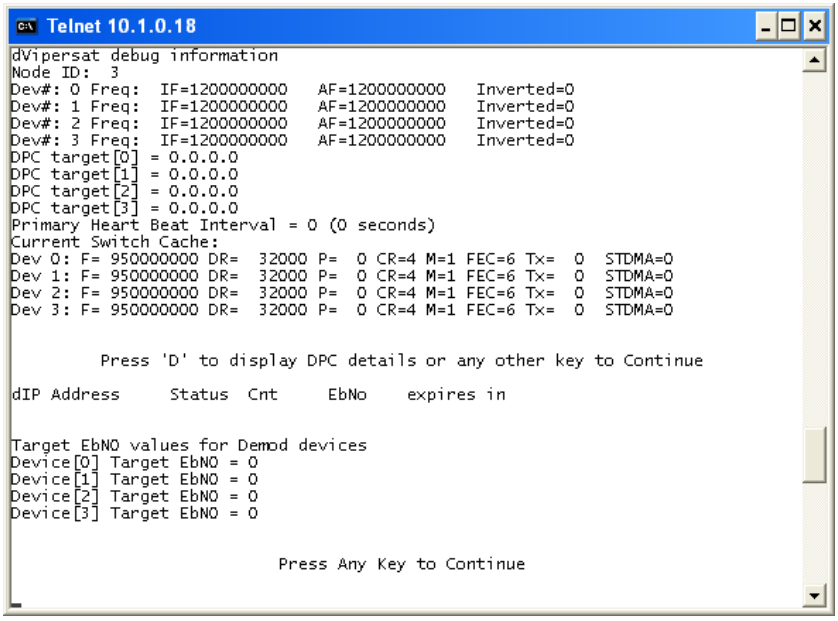


Figure 3-69 Vipersat Summary screen

The **Node ID** number that appears in this screen verifies that the unit is registered with the VMS and is active in the network. This number is automatically assigned by the VMS.

Note that the four Demods of the CDD-56X are designated as **0** through **3** on this screen. The **IF** values represent the Intermediate Frequency (Hz) that this unit is currently using. The **AF** values represent Adjusted Frequency (Hz), a translation of the IF that is used by the VMS for internal tracking of switching commands.

The **DPC target** entries are the IP addresses of the modulators that are to receive the Dynamic Power Control messages from the Demods for this unit.

The **Primary Heart Beat Interval** represents the time period between the communication check message that is sent from the primary Hub CDD-56X to the VMS in an N:M redundancy configuration. This interval is specified in the VMS.

Data for the **Current Switch Cache** reflects either the Home Satae information immediately after the unit boots, or the last switch command from the VMS (the last command sent to the base modem).

DPC details provide the status and E_b/N_o values for active Remotes in the group.

Vipersat Migration

The **Vipersat Migration** command is used to set the compatibility mode for the Hub Burst Controller when conducting a firmware upgrade on the associated Remotes. Although this command appears in the menu for both the Hub modem and the Remote modem, it only applies to STDMA Controllers and TDM Outbound modems at the Hub.

Enter **M** at the command prompt in the **Vipersat Configuration** screen to display the Vipersat Migration dialog shown in figure 3-70.

Refer to the specific upgrade procedure that is to be implemented for instructions on whether/how to utilize this feature.

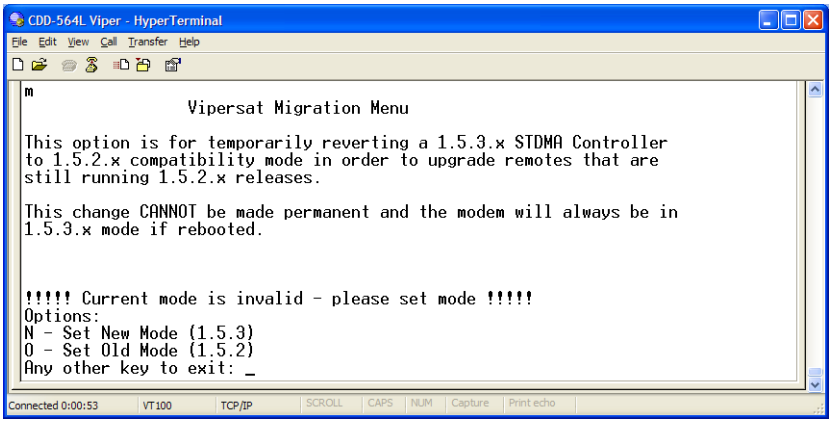


Figure 3-70 Vipersat Migration prompt

UDP Port Base Address

Should a particular network application require a specific **UDP port base address** be used, the default address can be changed by entering **U** at the command prompt in the **Vipersat Configuration** screen (figure 3-6).

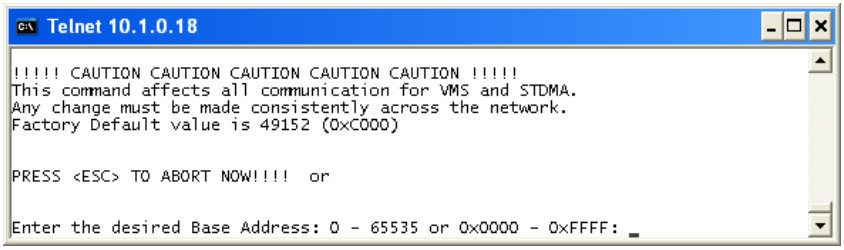


Figure 3-71 UDP Port Base Address prompt

Caution: This command affects all communications for the VMS and STDMA. If the base address is changed, it must be changed in the VMS as well as in all modems in all networks controlled by the VMS. The base address must also be changed when using VLOAD with this network.

Alerts

The **Alerts** menu item in the *Vipersat Configuration* screen is for information only and serves to display alert messages to the operator.

- *Example*: “Critical error: should not be in map”

  This alert typically occurs when there are multiple STDMA burst controllers at the Hub incorrectly configured with the same Group ID, thus causing Remotes to appear in more than one bursmap. A Remote may already be switched out into *d*SCPC mode, yet continue to appear in a burstmap that is received from another controller.

APPENDIX

A

NETWORK ADDRESSING

Introduction

This Appendix is an overview of network addressing and how it applies to configuring the CDD-562L/564/564L for use in Vipersat Networks. The subjects covered are:

- OSI Model
- Binary Math
- IP Addressing
- Network Address Translation
- Subnets
- Network Segments
- Default Gateways
- MAC Addresses

The OSI Reference Model

OSI is an acronym for Open Systems Interconnection. This is a network model created by ISO (the International Standardization Organization.) The OSI model is the basic standard which forms the basis for all networking protocols.

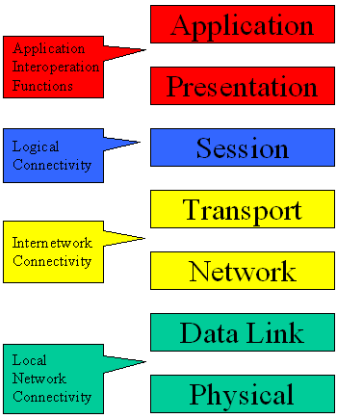


Figure A-1 The Seven OSI Protocol Layers

The OSI model defines the building blocks used to construct a working network protocol as shown in Figure A-1. The blocks on the right show the individual layers which make up the OSI model and the blocks on the left show the layer's functional grouping.

Each layer, as defined by the OSI model, is only aware of the layers directly above and below it.

Layers 1 – 3

Layer 1 / Physical – Layer 1 defines the physical means by which actual bits are sent and received. This layer, for example, is where connectors, cable lengths, and signaling specifications are defined.

Layer 2 / Data Link – Layer 2 consist of two sub-layers:

- Logical Link Control (LLC) – The LLC packages bytes received from the MAC into a format readable by the Network Layer above it.
- Media Access Control (MAC) – The MAC is concerned with obtaining access to the network at an appropriate time; i.e., when no other machines are communicating or when permission has been granted.

Together, these two sub-layer protocols are responsible for moving packets on and off the network.

Layer 3 / Network Layer – Layer 3 is responsible for routing packets through multiple networks. The Layer 3 protocol operates without regard to the underlying protocols in use. For example, routers operate at Layer 3.

Binary Math

Network devices communicate using BITS, where a bit is a single digit represented by a 1 or a 0, or by using BYTEs, where a byte is made up of eight bits in any combination of 1's or 0's. A byte is also referred to as an octet.

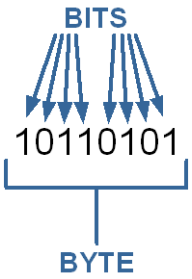


Figure A-2 Bits and Bytes

An octet can be converted to or from binary using the technique shown in the decimal conversion chart in Figure A-3. The conversion chart also shows the decimal equivalent of the binary number.

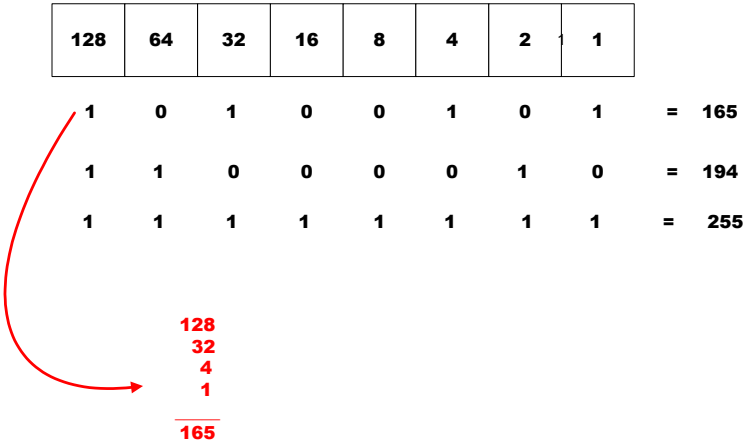


Figure A-3 Binary to Decimal Conversion

Bits containing a **1** in Figure A-3 determine which decimal values should be added. These decimal values, when added together, determine the decimal equivalent for the binary number.

This is an example of changing a number expressed in binary (base 2) to its decimal equivalent (base 10). The numeric value is the same, you have only

changed the numbering base (radix.) All digital processes are done in binary. The conversion to decimal is done whenever binary values need to be read or entered by humans as their decimal equivalents.

IP Addressing

An IP (Internet Protocol) address is a unique set of numbers assigned to a device on a network to uniquely identify that device (by its IP address).

An IP address is a unique number composed of four octets, with each octet separated by a dot. This notation style is called dotted decimal notation.

Each IP address can be broken down into two parts, as shown in the example below:

Example: **128.121.188.201**

The first two octets are the network ID: **128.121**
The second two octets are the host ID: **188.201**

- **Network ID** - In this example, the 128.121 portion of the IP address defines the network that a host belongs to, and is equivalent to a street name in a mailing address.
- **Host ID** - The 188.201 portion of the IP address specifies a unique number assigned to the host on the network, and is equivalent to a house number in a mailing address.

IP Address Classes

IP addresses are assigned to classes according the schedule shown in Figure A-4. IP address classes are assigned as follows:

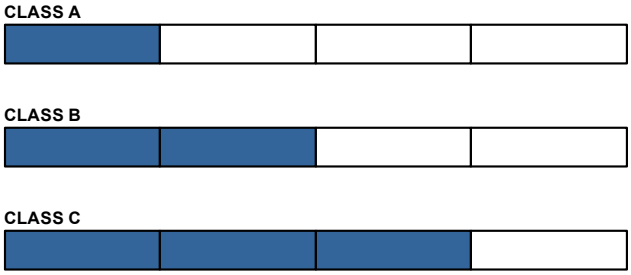
Class A

- 1.x.x.x to 126.x.x.x (0 and 127 are reserved)
- 126 Class As exist
- Can have 16,777,214 hosts on each Class A
- 8-bit network number
- 24-bit node number

Class B

- 128.0.x.x to 191.254.x.x
- 16,384 Class Bs exist
- Can have 65,354 hosts on each Class B

- 16-bit network number
- 16-bit node number



Address Class	High-Order-Bits	1st Octet Decimal Range	Networks Available	Hosts Available
Class A	0	1-126.x.y.z	126	16,777,214
Class B	10	128-191.x.y.z	16,384	65,534
Class C	110	192-223.x.y.z	2,097,152	254

Figure A-4 IP Address Classes A, B, C

Class C

- 192.0.1.x to 223.255.254.x
- 2,097,152 Class Cs exist
- Can have 254 hosts on each Class C
- 24-bit network number
- 8-bit node number

Class D

- 224.0.0.0 to 239.255.255.255
- Reserved for Multicast (messages sent to many hosts).

Class E

- 240.0.0.0 to 255.255.255.255
- Reserved for experimental use and limited broadcast

Private Network IP Addresses

RFC 1918 defines blocks of addresses for use on private networks:

- 10.0.0.0 – 10.255.255.255
- 172.16.0.0 – 172.31.255.255
- 192.168.0.0 – 192.168.255.255

Network Address Translation (NAT)

Private networks can only connect to the public Internet by using a Network Address Translation (NAT) device (a router, for example) or a proxy server which has been assigned a public IP address. These network devices use a public IP address to request information from the Internet on behalf of the private IP addressed devices on the associated private network.

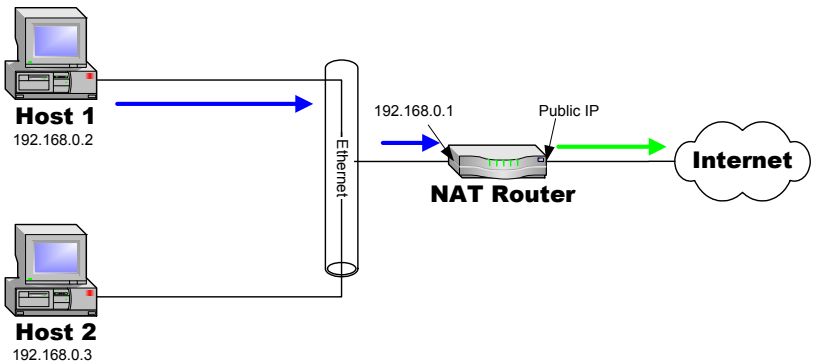


Figure A-5 NAT Router Example

This use of private addresses helps to conserve public IP addresses.

Subnets

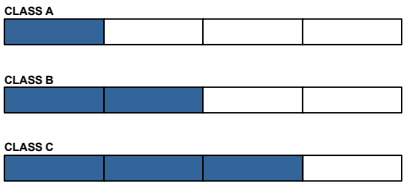
Subnets can be defined as the further segmentation of the InterNIC assigned Network ID IP address. The amount and type of subnetting performed by the organization is determined by the network layout.

In the process of subnetting, bits are borrowed from the host ID portion of an IP address and are then given to the network ID. Then a “Subnet Mask” gets assigned to the host along with the IP address.

Subnetting is required if the network is segmented.

Subnet Mask

The Subnet Mask is used by the host to determine if a destination IP address is on the local or on a remote network segment. The table in Figure A-6 shows the default subnet mask used for each class of IP address.



Address Class	Mask Decimal Value	Mask Binary Value
Class A	255.0.0.0	11111111.00000000.00000000.00000000
Class B	255.255.0.0	11111111.11111111.00000000.00000000
Class C	255.255.255.0	11111111.11111111.11111111.00000000

Figure A-6 Default Subnet Masks for IP Classes

The IP address and subnet mask work with each other to identify a network element or device. The subnet mask, like an IP address, contains 4 octets separated by a dot (.) and looks similar to an IP address.

The subnet mask determines what bits in the IP address are being used to determine the network ID by using the Boolean math operator **and** in a process called **and**ing. **And**ing compares each bit value in the IP address with the bit value in the subnet mask. The result of the **and**ing process determines which subnet the IP address is on. The Boolean **and** operator works as follows:

0 and 0 = 0
1 and 0 = 0
1 and 1 = 1

The table shown in Figure A-7 shows the **and**ing of two binary values and the corresponding decimal equivalents for each of the values.

	Dotted Decimal Address	Binary Values
IP Address	192.168.2.66	11000000.10101000.00000010.01000010
Subnet Mask	255.255.255.0	11111111.11111111.11111111.00000000
ANDing Result	192.168.2.0	11000000.10101000.00000010.00000000

Figure A-7 ANDing an IP address and a subnet mask

A calculator, available from SolarWinds, performs these IP and subnet mask calculations and can be found at:

http://www.solarwinds.com/products/freetools/index.aspx

Network Segments

A "Network Segment" is a portion of a network that is bordered by two router interfaces as shown in Figure A-8.

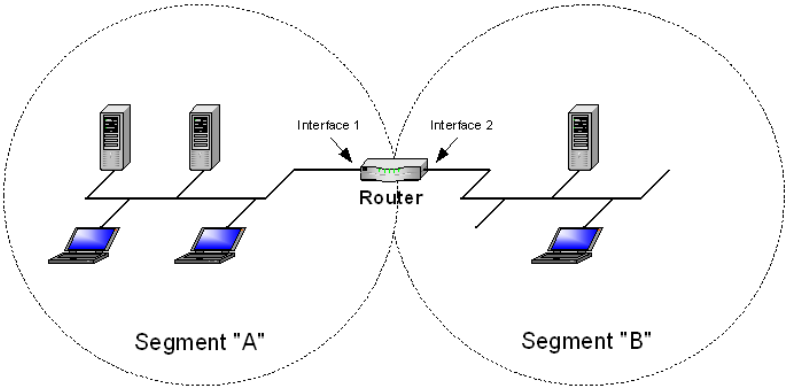


Figure A-8 Network Segments

Each network segment must either be on a different network or a different subnet. For example, if you have a single IP address available, you can change the default mask from 255.255.255.0 to 255.255.255.192. The resulting calculation yields four subnets:

- 192.168.100.0
- 192.168.100.64
- 192.168.100.128
- 192.168.100.192

Each of the four subnets can, in turn, support 64 members.

The example subnet used above yielded 4 subnets, but you can use a different mask to meet the specific requirements of your network.

Default Gateways

A default gateway is a network device, usually a router, that is responsible for routing data packets out of the local network segment.

The address of the gateway is entered into the devices on the local network, providing them with a location to send data that is destined for another segment.

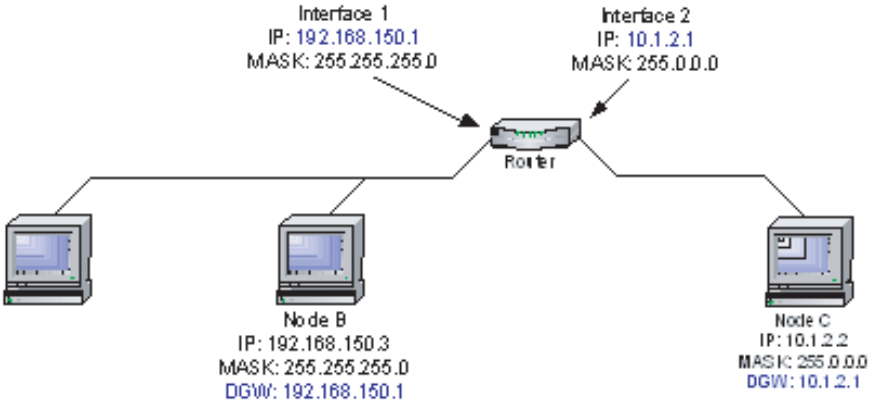


Figure A-9 Router as Default Gateway

MAC Addresses

A MAC address is a physical hardware address that gets assigned to the interface of a networking device. This address is typically created and burned into a device's ROM during the manufacturing process. MAC addresses are unique to the device and are not typically user-assignable.

The MAC address is used for Layer 2 (Data Link) communications between networking devices, and consists of 12 alpha-numeric characters as shown in the example below:

Example: **00-3f-bf-00-01-45**

- The first six characters are issued to the organization.
- The second six characters are assigned to the hardware interface by manufacturing.

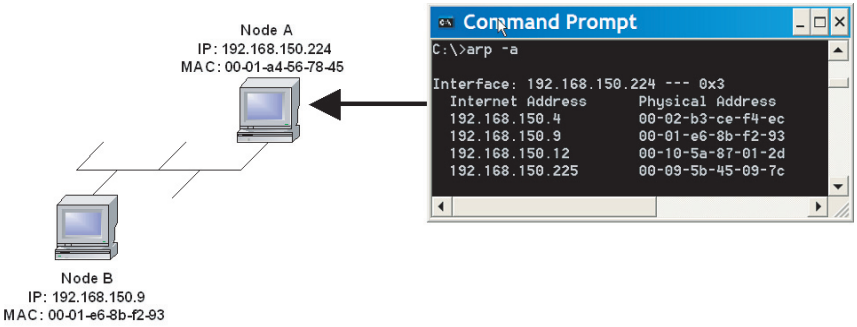


Figure A-10 Network Node MAC Addresses

APPENDIX

B

AUTOMATIC SWITCHING

General

Automatic switching is a feature of the VMS that allows dynamically changing the network configuration in response to changes in either network traffic loads (Load switching), traffic type (Application switching), or Type of Service (ToS switching) detecting stamped packets with Diffserv values. Entry Channel Mode switching is also covered.

These switching types are presented in the following material which uses CDM-570/L, SLM-5650A, and Series800 modem units for purposes of illustration. For simplicity, these units shall be referred to as modem/routers.

The basic signal topology in a Vipersat network is TDM (Time Division Multiplex) outbound and Vipersat's proprietary STDMA (Selected Time Division Multiple Access) inbound. The STDMA slots can have their duration and bandwidth allotments varied, tailoring bandwidth allocation to meet the bursty traffic load of a typical data network.

When required, a network is switched from STDMA to SCPC. SCPC bandwidth is allocated from a bandwidth pool by the VMS to meet QoS or other requirements for the duration of a connection. When the SCPC connection is no longer required, the bandwidth is returned to the pool for use by another client.

This basic structure gives the VMS-controlled network its flexible, automated network utilization and optimization capability.

The VMS has the intelligence to interpret the constantly changing statistics gathered by the Vipersat modem/routers and uses this data to issue commands

back to these intelligent modem/routers, effectively managing the Vipersat network operation in real time, and optimizing each site's bandwidth usage to meet their QoS and cost requirements within their bandwidth allocation. The result is a stable satellite network connection that automatically responds to the customer's requirements while continuously monitoring and reacting to changing load, data type, and QoS requirements.

Hitless Switching

Unless inherent delays in configuring both ends of a satellite bandwidth link during dynamic switching are accounted for, transmitted data may be lost during the transition. The time for a switch command to be sent across the satellite link (~ 250 ms), the command processing time, as well as receiver acquisition time must be considered. The Vipersat **Hitless Switching** feature provides a means to coordinate timing and utilize buffering to eliminate these data outages.

The parameters for configuring the Hitless Switching feature for a CDM-570/570L are set from the screen shown in figure B-1. This screen is accessed from the STDMA/SCPC Auto Switching screen (see figure B-2 and figure B-4).

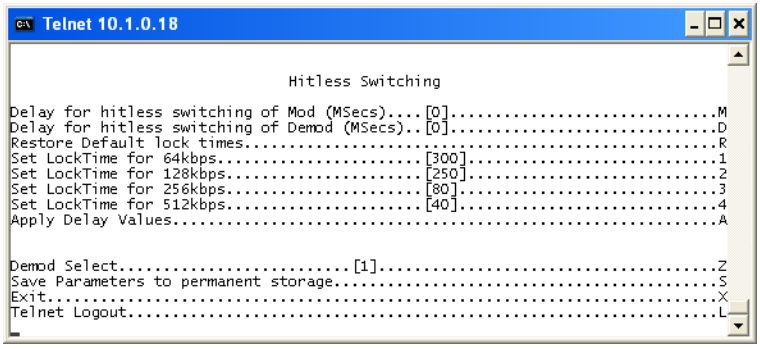


Figure B-1 Hitless Switching screen

- **Enable/Disable** – The Hitless Switching screen will initially display all lock times as -1, indicating that the feature is disabled. The *Restore Default Lock Times* command is used to enable this feature.
- **Delay for Mod** – This parameter allows the operator to insert additional delay to buffer more data after modulator transmission is ceased.
- **Delay for Demod** – This parameter allows the operator to insert additional delay to account for the tuning of the demodulator.

- **LockTimes** – LockTime settings for the four data rates displayed can be adjusted either up or down, but default settings based on satellite testing should be used as a starting point. These defaults are stored in each modulator/demodulator unit and are restored by entering **R** at the command prompt.

  Once restored, the lock time for each data rate can be modified by entering the corresponding number.

Load Switching

Overview

There are three primary functional components involved in the load switching process.

- **Hub Controller(s)**—These are the Hub units that provide the load switching detection mechanism for Remotes that are operating within the shared channel(s). Hub units that can serve as controllers include CDM-570, CDD-56X, CDD-880, and SLM-5650A.
- **Remote InBand Modem/Routers**—The Remote modem units provide the load switch detection mechanism when operating in dedicated SCPC return channel. These modems include CDM-570, CDM-840, and SLM-5650A.
- **VMS**—The Vipersat Management System provides the switched capacity and resource control for each request generated by the components described above.

Load Switching is the mechanism by which the Vipersat network switches a Remote terminal based on traffic levels at the Remote. This mechanism controls both the switch from STDMA to SCPC mode as well as switches for SCPC capacity changes. The main components of load switching in a Vipersat system: are the VMS (network management) and the Comtech modem/router. The VMS component receives switch requests from the modem/router, and based on policy settings and available resources, either grants or denies the request. Within the modem/router component, load switching is managed at either the Hub or the Remote, based on the current mode of operation. When a Remote is in STDMA mode, load switching requests for that Remote are managed by the Hub STDMA Controller. After a Remote has been switched to SCPC mode, it manages its own switching (or Step Up/Step Down) requests.

Note: For Hub STDMA Controllers operating in either *GIR* (Guaranteed Information Rate) or *Entry Channel Mode*, typical load switching *is not* the mechanism that performs the transition from STDMA to SCPC mode due to traffic load. In GIR mode, the Remote is switched to SCPC as soon as the GIR threshold is reached. In Entry Channel mode, the Remote is switched to SCPC as soon as the Hub receives the first transmission from the Remote.

For both GIR and ECM, the event of switching from STDMA to SCPC can only occur if the SCPC Switch Rate parameter is *set to a value greater than 0* (zero).

The basic concept for all load switching is that a running average of current utilization is maintained, and when that utilization exceeds a preset threshold, a switch is initiated. The data rate for the switch is computed by determining the current bandwidth requirement of the Remote, and adding some percentage of excess margin.

The main difference between switching from STDMA to SCPC and adjusting within SCPC is that in STDMA mode, the current available bandwidth is constantly changing, while in SCPC mode, it is constant between switches. Furthermore, switches from STDMA to SCPC mode are always caused by the traffic level exceeding the switch rate threshold. Within SCPC mode, switches can be caused by traffic exceeding an upper threshold or dropping below a lower threshold. However, in both cases the new data rate is based on the actual traffic requirements adjusted up by the margin percentage. Also, based on policy settings in the VMS, if a Remote requests less than the specified threshold amount of bandwidth, the Remote is put back into STDMA mode. The exception to this is a Hub controller operating in ECM whose Remotes will remain in SCPC mode but drop down to the specified entry rate.

Bandwidth Allocation and Load Switching by the Hub STDMA Burst Controller

As part of normal STDMA processing, the Hub monitors the traffic levels from each of the Remotes for which it is allocating bandwidth. This is done using the STDMA ACK management message (table B-1) that is transmitted at the beginning of each burst from the Remote. The STDMA ACK contains two metrics that are used by the Hub:

- The number of bytes received for transmission (Queued Bytes) since the last cycle.
- The number of bytes currently waiting to be transmitted (Bytes In Queue).

These metrics are used by the Hub for three purposes:

- Determine the amount of STDMA bandwidth (slot size) to allocate in the next cycle.
- Provide statistics of the amount of activity at each Remote (Average Bytes Received).
- Determine if a Load switch is needed.

Table B-1 STDMA ACK Message

Data Type	Size in Bytes	Description	Unit of Measure	Notes
IP	4	IP Address of Remote	N/A	Used by Remote to identify itself
Unsigned	4	Queued Bytes	Bytes	Total number of bytes queued since last cycle (includes possible buffer overflow)
Unsigned	4	Bytes in Queue	Bytes	Number of bytes currently queued
Unsigned	1	Group Number	N/A	Identifies the STDMA group that this Remote belongs to
Unsigned	1	Dropped Buffers	Packets	Number of packets dropped (due to limited bandwidth)

If there is adequate return path bandwidth available, the values of these two metrics will be the same. However, if there is not enough bandwidth to satisfy the traffic requirements of the Remote, or if the Remote has exceeded the maximum allocation, some data will be held for the next cycle. In this case, the number of Bytes in Queue will start to grow and will exceed the Queued Bytes. In other words, the Bytes in Queue is the sum of the data not yet transmitted plus the new data received.

If the condition is due to a short burst of data, the backlogged data will eventually be transmitted and the system will return to a sustainable rate. However, if the overload condition is due to long term increased activity, then the backlog condition will continue to grow and eventually trigger an SCPC switch. If the overload condition lasts long enough, buffer capacity will eventually be exceeded and some data may have to be discarded.

Note: This is not necessarily bad, as it is often more effective to discard old data than transmit it after it has become ‘stale’.

The “Bytes in Queue” metric is used to determine the STDMA bandwidth allocated (slot size) for the next cycle; the goal being to keep the data backlog to zero. The Hub uses this metric to compute the slot size for each Remote in the next cycle as follows:

- **Fixed Mode –** All Remotes get the same slot size, regardless of need. This is the only mode that uses a static assignment of available bandwidth; the *Bytes in Queue* metric is not used here.

- **Dynamic Slot Mode –** The slot size for each Remote is computed based on the time (at the current data rate) needed to transmit all the "Bytes in Queue". If the result is less than the minimum slot size or more than the maximum slot size, the slot is adjusted accordingly.
- **Dynamic Cycle Mode –** Available bandwidth is allocated to Remotes proportionally, based on current need. The Bytes in Queue for each Remote is divided by the total Bytes in Queue for all Remotes to determine the percentage allocation of bandwidth for each Remote.
- **GIR (Guaranteed Information Rate) Mode –** Initially computed the same as Dynamic Cycle, except there is no maximum limit. After all Remotes have been assigned slots, the Burst Map is checked to see if the total cycle length exceeds one second. If not, then all requirements are satisfied and the Burst Map is complete. However, if the cycle is greater than one second, then the slots are adjusted proportionally so that all Remotes receive at least their guaranteed rate plus whatever excess is still available.

  In the current design, when the one second restriction is exceeded, Remotes without a specified GIR are reduced to the global minimum slot size and the remaining bandwidth is distributed amongst Remotes that have been assigned a GIR rate. This approach is based on the assumption that Remotes that have been assigned a GIR are paying a premium and should benefit from available excess bandwidth when needed.

  Note that the GIR allocations are restricted so that the assigned GIR totals cannot exceed available bandwidth. If this restriction is somehow violated, then it will not be possible to properly allocate bandwidth when the network is overloaded.
- **Entry Channel Mode –** This is the same as Dynamic Cycle, except that as soon as the Hub receives an STDMA ACK, it initiates a switch to SCPC mode based on the policy set for that Remote.

  Note that load switching is disabled for ECM Remotes while operating in STDMA mode.

The important thing to understand about "Bytes in Queue" is that any data that is not transmitted (i.e., does not fit) in the next slot will be reported again in the next STDMA ACK. Thus the "Bytes in Queue" is not necessarily an accurate measure of the actual traffic being passed through the Remote.

The "Queued Bytes" on the other hand, reflects only the data that was received in the last cycle and thus is never duplicated (not including TCP retransmissions). This is the metric that is used for computing average load and initiating a load switch as needed.

Load Switching—STDMA Hub

Before discussing how load switching is determined, it is necessary to explain the modem/router parameters that control the switch.

Hub Switching Parameters

The screens shown in figure B-2 (CDM-570/570L modem/router) and figure B-3 (SLM-5650A modem/router) are examples that show the entries in the Automatic Switching page at the Hub that are used to control load switching.

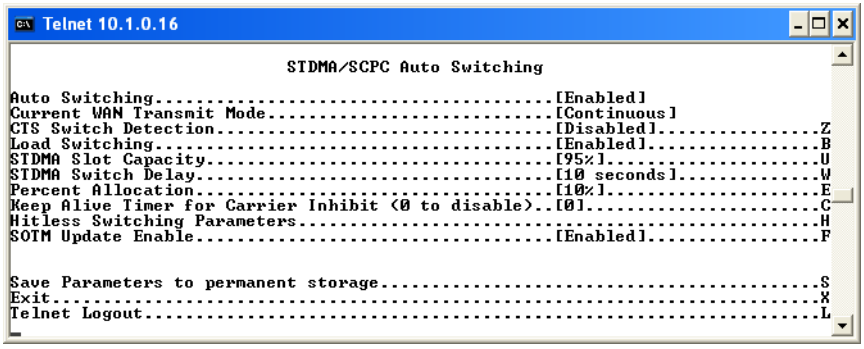


Figure B-2 Auto Switching Menu, CDM-570/570L Hub

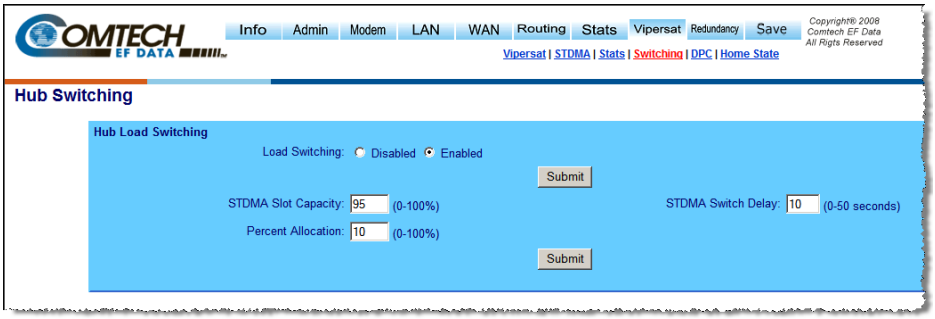


Figure B-3 Hub Load Switching Page, SLM-5650A

- **Auto Switching –** This is a Vipersat feature that is enabled in the CDM-570/570L **Features** menu. If Auto Switching is not enabled, Load Switching will be ignored. There is no automatic switching enable button in the SLM-5650A modem configuration menus; the operator enables each switching function individually.

- **Load Switching –** This is a type of Automatic Switching that is based on the amount of traffic at a Remote. If this feature is not enabled, then no Remote in this STDMA group will be switched based on load.
- **STDMA Slot Capacity –** This is a threshold value. When the amount of outbound traffic at a Remote exceeds this percentage of the current STDMA slot capacity, a load switch is initiated. It is important to understand that in most STDMA modes, the amount of bandwidth allocated to a Remote varies with need and thus from cycle to cycle. Thus the amount of traffic that constitutes X% will also vary from cycle to cycle.

  Note for Dynamic Cycle mode:
  Since Dynamic Cycle mode tends to provide no more bandwidth than is needed, Remotes will typically appear to be near 100% capacity whenever they are passing real traffic. Thus, in this mode, if the threshold is set too low, switches will occur unnecessarily.
- **STDMA Switch Delay –** This is a built-in latency that forces a Remote to maintain an average load over some number of seconds after reaching a switch condition before the switch is actually initiated. This prevents switches due to momentary traffic bursts.
- **Percent Allocation –** This is an excess amount of bandwidth that is allocated beyond the current traffic rate when the switch to SCPC is made. For example, if the current average traffic at the time of the switch is 60 kbps, and the **Percent Allocation** is 10%, then the allocation will be for 60k + 6k = 66 kbps.

  Note that, because the Hub always allocates bandwidth in 8 kbps blocks, the 66 kbps will be rounded up to 72 kbps in this example.

Hub Switching Process

Each time the Hub receives an STDMA ACK, it computes the average load for that Remote. This average is then compared to the bandwidth currently allocated to the Remote.

For example, if a Remote gets a 50 ms slot in an upstream that is running at 512000 bps, then it can transmit 0.050 * 512000 = 25600 bits = 3200 bytes. If the Queued Bytes was 3000, then for that cycle, the Remote was at 3000/3200 = 93.75% of capacity. If the current cycle time is exactly 1 second, then the effective data rate of the Remote is also 25600 bits per second. However, if the cycle time is only 500 milliseconds, then the effective data rate is actually 25600/.5 = 51200 bits per second. The effective data rate is important for calculating switch data rates.

If the average bandwidth used exceeds the threshold percentage of available bandwidth, then a flag is set indicating a switch is pending. At this point, the statistics are reset and the traffic load is then computed for the time period specified by the switch delay. At the end of this delay, if the threshold is still exceeded, a switch is initiated. The data rate specified for the switch is determined by taking the current load, as indicated by the bytes queued during the delay period, multiplying it by the percent allocation and rounding up to the next 8 kbps.

A key point is that in most of the STDMA modes, the bandwidth allocated to each Remote is constantly being adjusted to the needs of the network. As long as the network is running below capacity, most Remotes will get the bandwidth they need and a switch will not be required. Only when a Remote requires more bandwidth than is available in STDMA will a switch occur.

In Dynamic Cycle mode, each Remote will always appear to be running at near 100% capacity, even when there is actually excess bandwidth available. This is because in this mode, the Remotes are almost never given more bandwidth than they need. As a result, the algorithm for this mode uses a maximum allowed slot size rather than the actual allocated slot size to calculate the effective data rate. This results in a more accurate estimate of the available STDMA bandwidth.

Load Switching—Remote

Once a Remote has been switched from STDMA mode to SCPC mode, it checks its bandwidth requirements to see if a change is needed. A running average of the data traffic passing over the WAN is maintained as a percentage of the current data rate for the Remote. This average is accumulated for at least the specified delay (Step Up/Step Down) period. Then, once per second, the current utilization is checked against the Step Up and Step Down Thresholds. If the utilization is outside the up/down range, a request is generated to switch to the calculated rate. After the request is granted, the running average is reset and the cycle is repeated.

Remote Switching Parameters

The parameters for controlling the Step Up/Step Down switching process for a CDM-570/570L Remote are set in the page shown in figure B-4. An example of this page for an SLM-5650A Remote is shown in figure B-5.

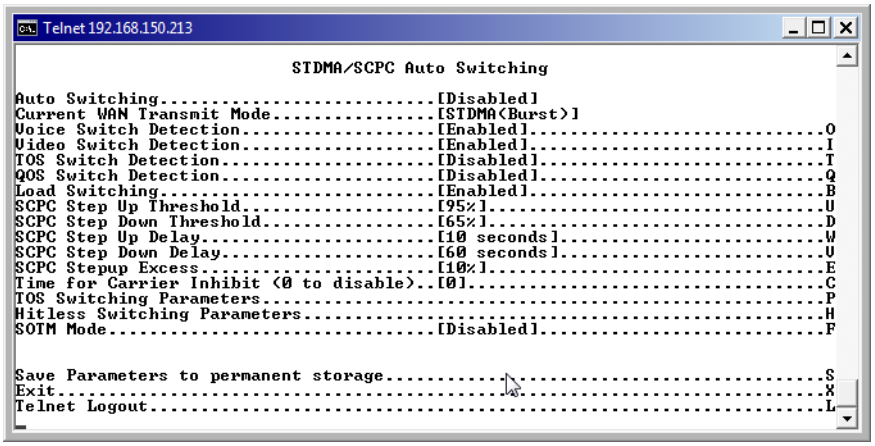


Figure B-4 Auto Switching Menu, CDM-570/570L Remote

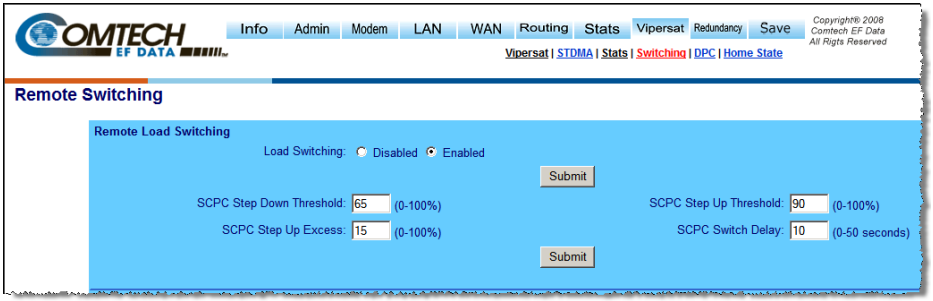


Figure B-5 Remote Load Switching Page, SLM-5650A

- **Auto Switching –** This is a Vipersat feature that is enabled in the CDM-570/570L **Features** menu. If Auto Switching is not enabled, Load Switching will be ignored. There is no automatic switching enable button in the SLM-5650A modem configuration menus; the operator enables each switching function individually.
- **Load Switching –** This is a type of Automatic Switching that is based on the amount of traffic at the Remote. If this feature is not enabled, then this Remote will not be switched based on load.
- **SCPC Step Up Threshold –** This is a window threshold that initiates a load switch to a higher data rate when the amount of traffic as measured within the transmit queue exceeds this setting. The value is specified as a percentage of the current data rate.

  Similar to the Hub parameter *STDMA Slot Capacity*.

- **SCPC Step Down Threshold –** Similar to the *Step Up Threshold*, except *Step Down* is used to trigger a switch to a lower data rate when the average traffic load falls below the set value.
- **SCPC Step Delay –** This is a built in latency that forces the Remote to maintain an average load for the specified period (seconds) that exceeds the switch threshold before a switch to a new data rate is actually initiated.

  Similar to the Hub parameter *STDMA Switch Delay*. However, the Remote offers two switch delay parameters once the unit has entered SCPC mode: a ***Step Up*** and a ***Step Down***. This provides the operator the option of specifying, for example, a shorter step up delay and a longer step down delay to ensure bandwidth requirements are quickly met and sustained while minimizing repeated switch events due to short-term fluctuations in the data rate.
- **SCPC Step Up Excess –** This is an additional amount of bandwidth that is allocated beyond the calculated traffic rate, and is added to each switch request.

  *Note that the value applies to both **Step Up** and **Step Down** switches, and is computed against the average traffic load at the time the switch is initiated.*

  For example, if the current average traffic at the time of the switch is 130 kbps, and the **Step Up Excess** is 10%, then the allocation will be for 130k + 13k = 143 kbps. And because bandwidth is always allocated in 8 kbps blocks, the rate will be rounded up to 144 kbps.

  Same as the Hub parameter *Percent Allocation*.

Determination for Switching

The following process is used to determine if bandwidth utilization warrants a change, and thus a switch to a new data rate.

The operator defines both a Step Up and Step Down threshold in terms of percent utilization, a bandwidth margin value, and a latency or averaging period. Once per second, the modem/router software determines the current percent utilization by dividing the bits transmitted by the current transmit data rate.

If the percent utilization exceeds the step up threshold or is less than the step down threshold for the entire latency period, then a Switch Request is sent to the VMS. The bandwidth requirement in the request is computed by taking the average percent utilization over the latency period and multiplying that by the current data rate to determine the actual data rate used over the measured interval. This number is multiplied by the margin value and rounded up to the nearest 8 kbps to determine the requested bandwidth.

Load Switch Example

An automatic load switching example, illustrated in the schematic diagram in figure B-6, illustrates how a network can respond to changes in traffic volume or load conditions. The network's capability and method of response to load changes is determined by the setting and capability of each of the components in the system, such as the transmitter power output, the antenna capabilities for each of the sites in the network, and the policies set in the VMS.

The elements for determining policies and their interactions are covered in this section.

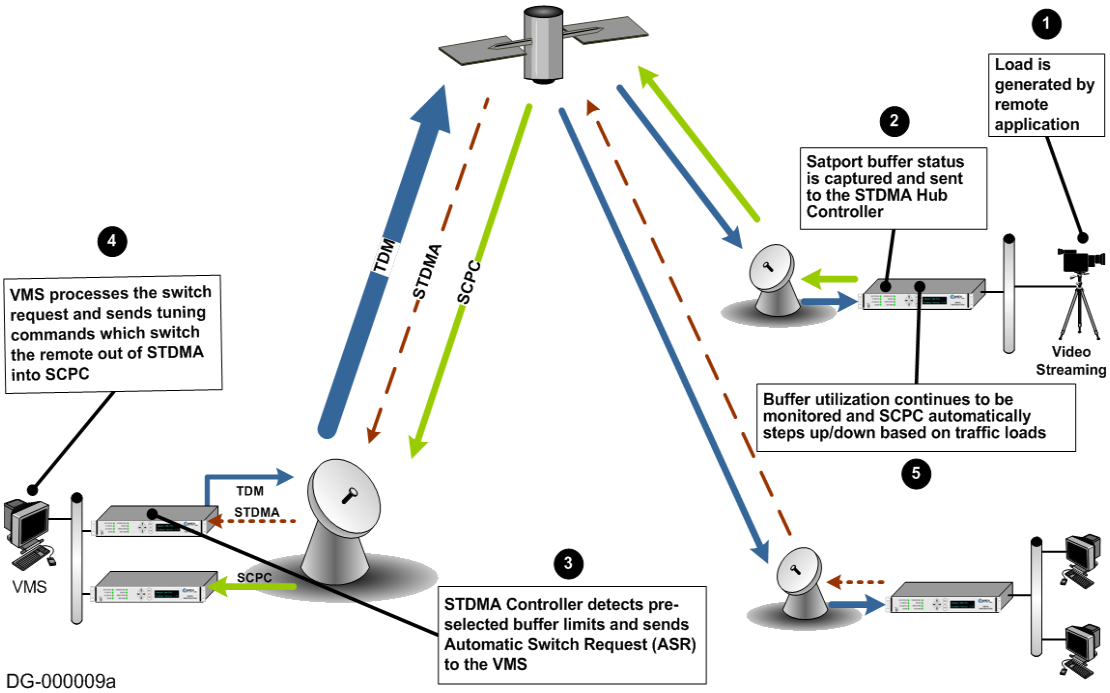


Figure B-6 Load Switching diagram

A load switch is illustrated in figure B-6 using the following process:

1. A load is generated by an application that is running at a Remote. In this example, the application is a video stream.
2. The data is connected to the Remote modem/router over an Ethernet link for transmission to the satellite. While the data-stream transmission is in progress, the Satport buffer status is captured and the Remote's buffer status is sent to the STDMA Hub Controller.

3. The STDMA Controller compares the Remote's pre-selected buffer limits with its buffer status and, if the buffer status exceeds the preselected limits, the STDMA Controller increases the time-slot allocated to that channel. If this brings the buffer status within established limits, no further changes are made.

4. If the buffer status continues to exceed the preselected limits, the STDMA Controller sends an ASR to the VMS.

5. The VMS processes the switch request by checking for available resources: first determining if there is a free demodulator, and then determining the channel space (bandwidth) requirements to accommodate the data flow requested by the STDMA Controller.

6. If the VMS finds available resources, it processes the switch request and sends tuning commands that switch the Remote out of STDMA and into SCPC mode.

The modem/router continuously monitors traffic flow volume. Whenever a preset upper or lower limit is exceeded, the modem/router sends a request to the VMS to change bandwidth by the amount needed to meet the new requirement. By this process, the bandwidth is continuously optimized in real time, precisely accommodating circuit traffic volume.

The ideal condition is for utilization of the channel to reach approximately 90%, thus optimizing the use of available bandwidth. The ability to actually accomplish this is limited by the currently available carrier bandwidth and, ultimately, the power output and antenna size available at the transmitting Remote site.

If the requested bandwidth is not available, the STDMA Controller will continue to receive buffer status reports from the Remote indicating that buffer flow is continuing, and the STDMA Controller will, in turn, continue to request additional bandwidth from the VMS. When bandwidth does become available, the VMS will perform the switch the next time that the STDMA Controller makes the request.

If the video data stream ends before the switch in bandwidth is completed, the channel is closed, the bandwidth which had been allocated is made available again to the pool, and no further action is taken.

Reduced Data Flow in Switched Mode (SCPC)

In the event the data flow is reduced—for example, a streaming file transfer terminates—the SCPC switched demodulator detects the reduced flow and notifies the VMS. The VMS will then send a switch command to reduce the size of the carrier bandwidth to the newly calculated requirement.

This entire process is automatic, following the policies established for the network. The network is dynamically modified, changing configuration to automatically respond to changes to the network's load.

The Home Threshold is the bit rate set to trigger a return to the home condition. This function is used when bandwidth has been allocated to meet load requirements, and then the load has been either removed or partially removed. The Home Threshold is used to determine whether the current bit rate has fallen below this preset level and, if so, the channel is switched back to its home condition (STDMA mode, for example).

Application Switching

Note: This Application Switching section refers to functionality of the CDM-570/570L modem/router. Application Switching is not available for SLM-5650A modem/routers.

Application switching, illustrated in figure B-7, also is capable of changing bandwidth use, but the change is determined entirely by the type of application being requested, ignoring load requirements.

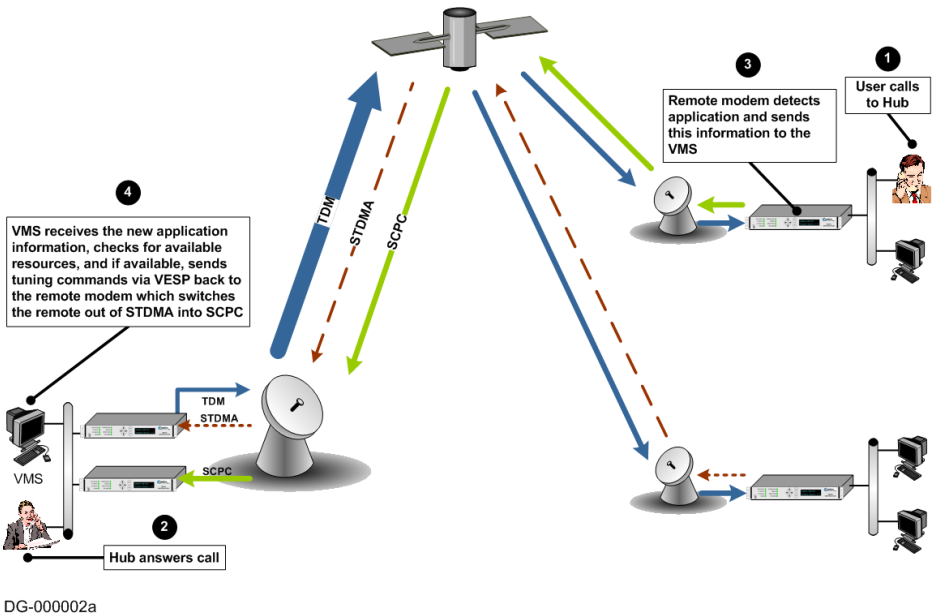


Figure B-7 Application Switching diagram

In a system configured for application switching, the Remote site modem/router looks for a packet in the data stream coming from the LAN that is configured using the H.323 stack protocol and containing an H.225 signaling protocol. In the diagram above, the signal is a voice call initiated at the Remote site.

The packet is examined to determine the port number, then, from the allocated port ranges, the modem/router determines the type of application being sent.

The modem/router sends a switch request to the VMS requesting a carrier for the application type. Typical applications include:

- Video
- Voice over IP (VoIP)

Each application type will have been assigned a bandwidth allocation when the policy for the Remote is established. The voice application, for example, might have had the bandwidth set in the policy to handle three simultaneous voice connections. When a VoIP protocol is detected in the H.225 signaling protocol, the modem/router requests the VMS to switch the bandwidth to accommodate three voice circuits.

The same process applies if the protocol detected is Video.

When *both* VoIP and Video are requested, the bandwidth required for the Video is used and the VoIP, which has priority, shares the SCPC with the Video.

Once the VMS receives the request to switch, it determines if there is a free demodulator and if there is bandwidth space available to handle the requested application. If the resources are available, the VMS then performs the switch.

Applications are streaming data. The Remote looks at the streaming data flow until it sees a break in the data exceeding 10 seconds. Once a break is detected the modem/router presumes that the application is terminated (or has malfunctioned), drops the carrier, and makes the bandwidth resources available for another service.

ToS Switching

ToS Background

The Type of Service (ToS) byte is an 8-bit field contained within the IP header portion of an IPv4 packet. This field provides a means of marking packets for traffic identification and classification purposes. Devices within the network can utilize the ToS value to classify traffic and apply per hop queuing and Quality of Service (QoS) for different types of traffic.

The first 3 bits of the ToS byte are referred to as IP precedence bits. The IP precedence bits and the next 3 bits combined are known as the Differentiated Services Code Point bits (DSCP). The 6 bits of DSCP allow for 63 discrete traffic identifiers. The DSCP field is the portion of the ToS byte that can be detected by the SLM-5650A modems and can be used for dSCPC switching within a Vipersat network. Figure B-8 provides a graphical representation of the ToS field within an IPv4 packet.

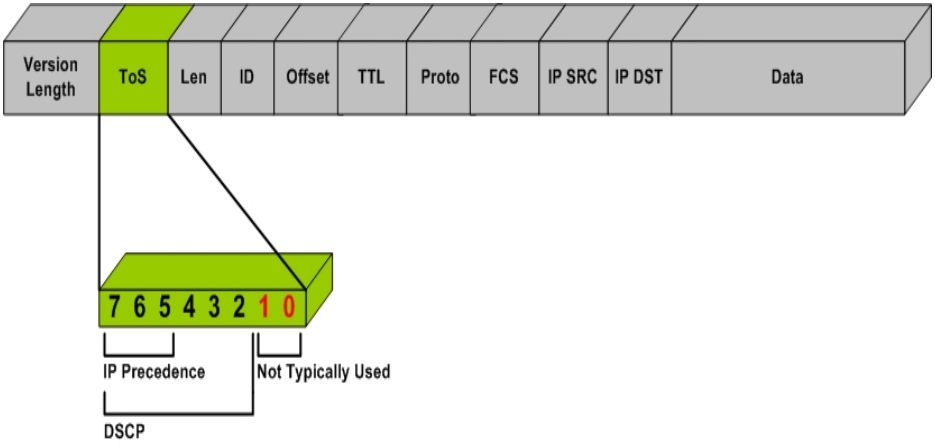


Figure B-8 ToS Field Location within the IP Header

The process of marking a packet with a ToS value is typically done in one of two places, either by the application device itself (e.g., VoIP phone), or by the packet marking capabilities of a network device such as a router.

Encrypted networks often pose additional limitations for prioritizing and classifying traffic. When encryption is applied to an IP packet, a majority of the information is no longer available for classification. Application layer protocols can no longer be detected by routers for classification purposes. In many encrypted environments the IP header, which includes the ToS value, typically remains in

the clear and often provides the only mechanism for identifying and prioritize traffic within the network.

The ToS switching feature in the SLM-5650A provides a reliable method for performing automatic dSCPC switching and is the preferred method for most encrypted environments that leave the IP header intact.

Detection of ToS Stamped Packets

The configuration and detection of ToS stamped packets occurs in the Network Processor (NP) card of the remote modem. In the remote modem, the user defines the ToS value to be detected and specifies the bandwidth to be requested, should that value be detected.

Once a packet with the ToS value is detected, the modem will send a switch request to the VMS. The VMS will then determine if policy settings, hardware, and bandwidth are available, before sending out tuning commands to reconfigure transmission communications.

Only IP traffic that is coming from the Ethernet port and is destined for the Satellite interface will trigger a switch. Traffic coming from the hub or another remote will not trigger a switch, regardless of the ToS value within the packets. This means that an application or remarking device located at the remote must be the source for stamping packets that are transmitted out of the remote site and over the satellite.

A tear down request is sent by the remote modem to the VMS if no more packets are detected with the ToS value after a user definable timeout occurs.

ToS switching can also be utilized in non-encrypted networks. One advantage for this is that each packet associated with the application will have ToS set, thus making ToS switching extremely reliable. A drawback, however, is that unless each application can set a different ToS value, granular resolution per application will be lost.

Note: Only ToS stamped IP traffic that is coming from the Ethernet port of a remote modem and is destined for the Satellite (WAN) interface will trigger a switch request.

Configuration

The ToS switching feature can be configured within the SLM-5650A modem using either the CLI or the Web user interface. For simplicity, the Web interface (figure B-9) will be presented in this example.

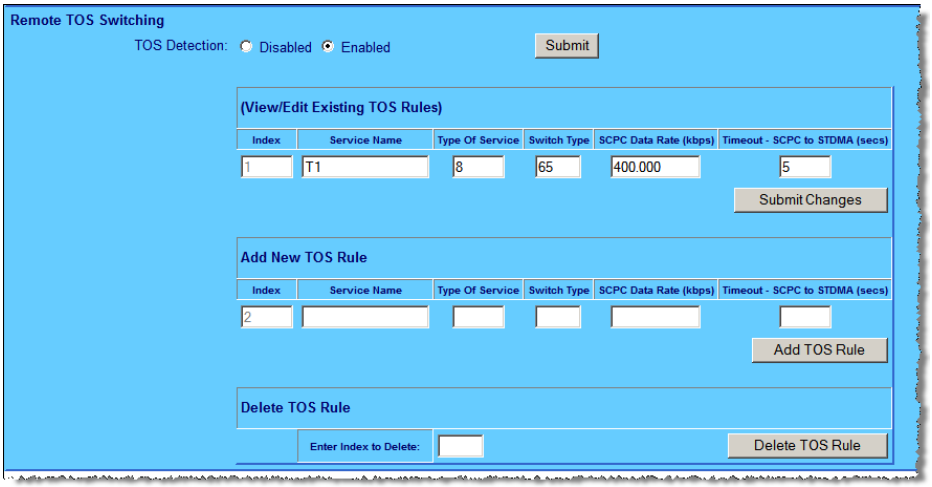


Figure B-9 Remote ToS Switching menu

The remote ToS switching is optioned by selecting 'Enable' or 'Disable'. In addition to the enable/disable control, the menu provides the ability to create a list of ToS Rules for which a switch will be initiated. In defining these fields, certain characteristics are created depicting what types of switch service connections are established. These fields are described in table B-2.

Table B-2 ToS Switching Settings

Field	Values	Description
Service Name	Text (15 char max)	A user defined ID association.
ToS ID	1 - 63	The ToS value for which a switch should occur. Note that 0 can not be used to set a ToS based switch.
Switch Type	64 - 254	The type of Vipersat switch which will occur for this ToS value.
SCPC Data Rate	kbps	The data rate for the switched SCPC link.
SCPC Timeout	seconds	The number of seconds of inactivity before the SCPC circuit will be torn down.

NOTE

Note: Load switching by the VMS is not affected by enabling ToS detection.

Example Implementations

ToS Switching Per Device

For applications that require an increase in SCPC bit rate for each application device, a separate ToS value must be assigned to each device individually. This provides granular switching for each device and also allows a mesh connection to be established for each device independently. Figure B-10 depicts a per device configuration example.

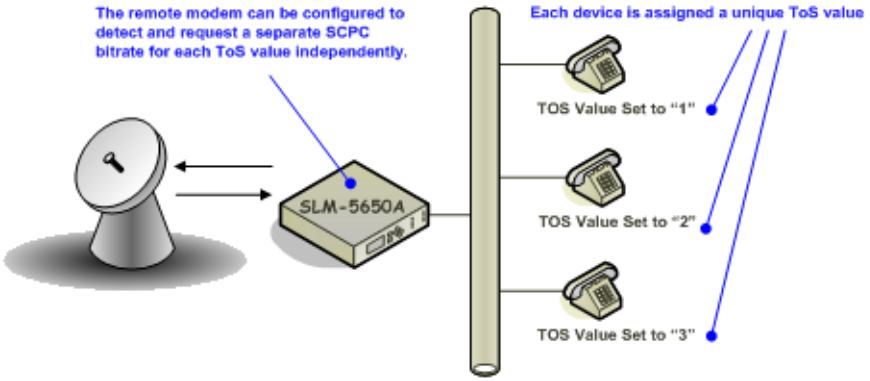


Figure B-10 Per Device ToS Switching Example

ToS Switching Per Traffic Type

For applications that only require a single SCPC bit rate, regardless of the number of active application devices, the same ToS value can be assigned to each device. This method does not provide granular switching for each device and a mesh connection will only be set up for the first device that sends packets with the designated ToS value. Figure B-11 depicts a per traffic type configuration example.

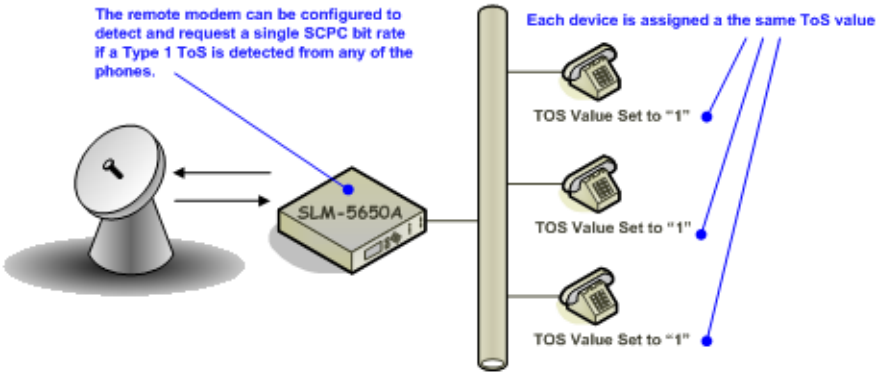


Figure B-11 Per Type ToS Switching Example

ToS Remarking

For situations where the application device is not capable of stamping a packet with a ToS value, or where the application traffic is generated by a variety of different hosts and protocols, ToS remarking should be considered. ToS remarking refers to a device, such as a router, that has the capability of re-stamping packets with a user defined ToS value. Devices that support remarking often allow users to assign a ToS value to packets that match certain source or destination IP addresses, port numbers, and/or protocols.

Example 1: A user wants to switch up whenever a host performs an FTP across the satellite. A device that supports remarking can be placed between the applications and the remote modem. The device can then be configured to stamp all traffic that utilized FTP port 21 with a particular ToS value. The remote modem can then be configured to detect this value and switch to a specific SCPC bit rate.

Example 2: A remote customer is using an IP based video encoder to transmit video over the satellite. The encoder does not have the option to assign a ToS value for prioritization. Again, a remarking device can be placed between the encoder and the remote modem and configured to assign a ToS value to all packets received from the encoder.

Figure B-12 provides an example of a router performing ToS remarking for VoIP phones.

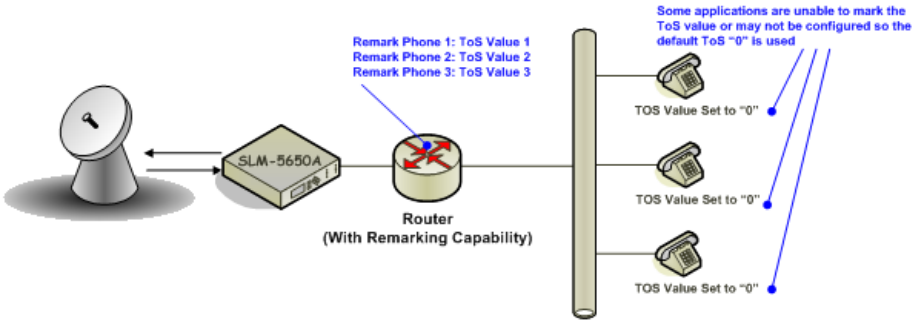


Figure B-12 ToS Remarking Application

ToS to DSCP Value Conversions

Application devices or remarking devices often have different ways of displaying or configuring the ToS or DSCP values used to mark packets. Some devices require the user to input the ToS value while others require input of the DSCP value. Depending on the manufacturer, these values may be displayed in binary, decimal, or hexadecimal formats.

The information below can be used to convert between various formats:

Convert from ToS to DSCP - Divide the ToS decimal value by 4

Example: Convert a ToS decimal value of 184 to DSCP

DSCP = 184/4

DSCP = 46

Converting ToS and DSCP to/from Binary - Figure B-13 provides an example of the conversion to and from binary and can also be used to convert to and from ToS and DHCP values.

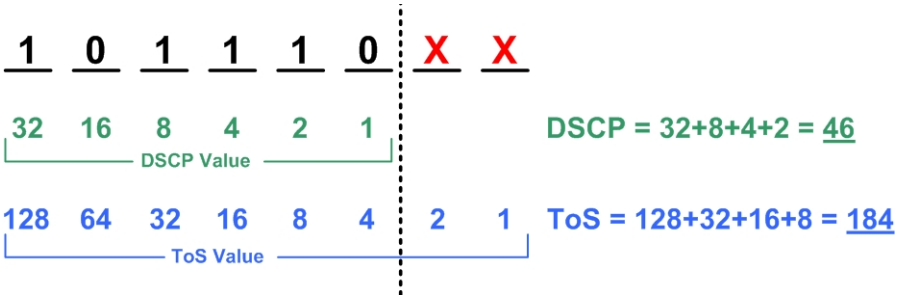


Figure B-13 ToS and DSCP Conversion Chart

Mesh Setup Based on ToS Detection

The detection of a ToS stamped packet by a remote modem can provide the means for setting up a Single Hop On Demand (SHOD) mesh connection from that remote to another remote within the network. *For these SHOD connections, it is assumed that each remote site that is part of the SHOD connection has, at minimum, one additional demodulator configured as a Remote Expansion.*

When a remote modem detects a packet that has been stamped with a ToS value that matches the user defined value, the modem will look at the destination IP address within the packet. The remote modem will then send a switch request to the VMS requesting the user defined bandwidth. The switch request also contains the address that the ToS stamped packet was destined for. The VMS processes the switch request and compares the destination address to the list of known subnets to determine if the destination belongs to another remote within the network. If the address does belong to another remote, the VMS will look for available hardware and bandwidth and then issue tuning commands to set up the connection. Each direction of the mesh is set up independently; i.e., the detection that occurs at remote 1 will establish a connection from remote 1 to the other remote involved. However, the other remote must perform detection for set up in the opposite direction.

Entry Channel Mode Switching

Entry Channel Mode (ECM) provides a method for Remotes requiring SCPC access channels to enter/re-enter the network, initially or after a power or other site outage.

Two versions of Entry Channel Mode switching are used in Vipersat networks. The version that is available for implementation in a Vipersat network will vary depending on the satellite modem model that is deployed in the network. *STDMA ECM* is currently available for CDM-570/L and SLM-5650A modems. *Dynamic ECM* (ECMv2) is currently available for CDM-570/L modems and the Advanced VSAT Series800 modems that include the CDM-800, CDM-840, and CDD-880.

STDMA Entry Channel Mode

With STDMA Entry Channel Mode, the switch time will be variable based on the burst rate (bps) of the STDMA group, the number of Remotes with slots in the group, and where in the burst cycle the Remote is when it acknowledges receipt of the burst map.

Initial SCPC rates are settable for each Remote in the STDMA group(s). Upon detection of a burst map acknowledgement from a Remote, the STDMA burst controller will send a switch request to the VMS with the operator-specified initial SCPC rate. Upon determining that there is an available demodulator and sufficient pool bandwidth, the VMS will send a multi-command to remove the Remote from the STDMA group, tune it and the switched demodulator to the specified initial bit rate and selected pool frequency. The Remote will stay at this initial rate unless an application (such as VTC) or consistent load causes it to request additional bandwidth from the VMS.

The initial switch from Entry Channel Mode to SCPC mode is not driven by the presence or absence of customer traffic. Once in SCPC mode, the switched initial data rate becomes the new temporary home state. This temporary home state sets the low limit data load threshold, where the Remote will stop sending load switch request commands. ECM Remotes in SCPC mode do not require burst maps to maintain SCPC transmission.

Note: Remotes operating in ECM toggle directly from STDMA to SCPC. The initial SCPC switch state is used instead of the modem's internal Home State.

After the ECM Remotes are processed into SCPC, the burst controller drops into sanity mode, sending a keep alive map to service Remotes which may have

their SCPC carrier inhibit flag set. The keep alive message is sent once every two seconds until re-entry is invoked.

Fail-Safe Operation

For Entry Channel Mode switching, it is useful to describe the fail-safe mechanism used for freeing pool bandwidth.

If the VMS loses communications with a switched Remote for more than three minutes, it will attempt to return the Remote to its home state. If the revert-to-home state command succeeds (restoring communications), Entry Channel Mode will cause the Remote to switch to its initial SCPC bit rate.

If the revert-to-home state command fails, the VMS will send a command to return the Remote and the Hub demodulator to the state where they were prior to losing communications, but leave the Remote enabled in the STDMA burst controller. This provides the Remote with 2 paths to rejoin the network:

1. If the outage was the result of a power loss at the site, the Remote will reboot in its home state (STDMA), then acknowledge the receipt of the first burst map, causing it to rejoin the network through ECM. The VMS will park the demodulator previously in use and free the bandwidth slot.
2. If the outage was due to an extended rain fade or other communications blockage with no loss of power, the Remote will rejoin the network via the previously assigned SCPC channel. When the VMS receives a PLDM, it will send a revert-to-home state command and free the bandwidth slot and burst demodulator. The Remote will then rejoin the network through ECM.

Since it is not possible to know which of the above scenarios caused the communications outage, the VMS will not free the bandwidth slot except through operator intervention.

Figure B-14 and figure B-15 diagram the time state differences and the process of recovery. Note that the times referenced in the diagrams are approximate.

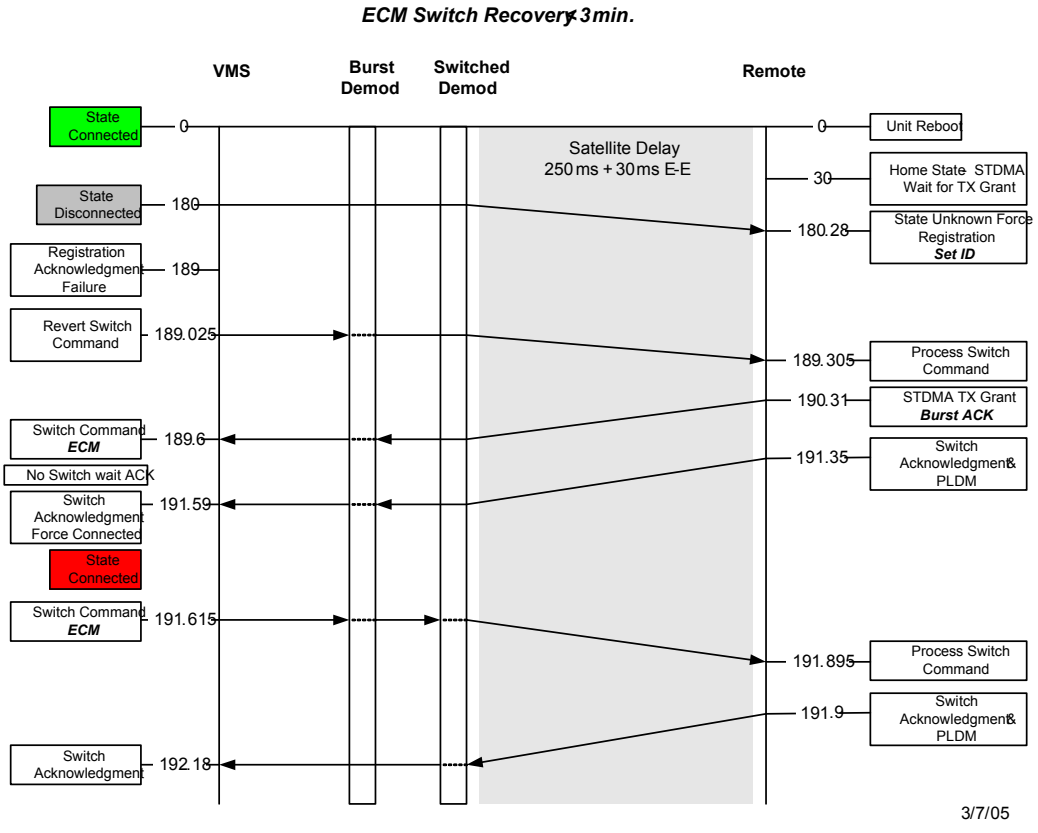


Figure B-14 ECM Switch Recovery: < 3 minutes

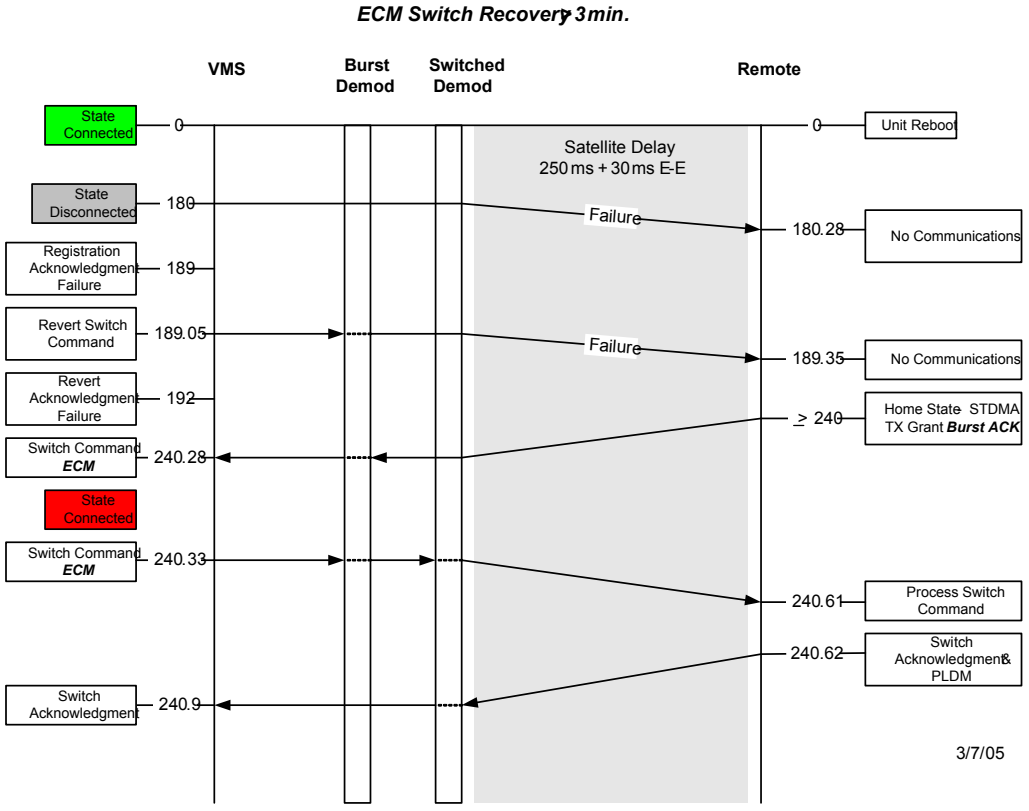


Figure B-15 ECM Switch Recovery: > 3 minutes

Using STDMA ECM

Entry Channel mode operates slightly differently from other STDMA modes due to the STDMA burst controller losing the ability to automatically control the modem unit once it is operating in SCPC mode.

Once the switch from ECM to SCPC has occurred in the modem, the unit no longer sends switch requests so VMS does not have a switch request to respond to switch the modem back to STDMA from SCPC mode. The operator will have to manually intervene to force a switch back into STDMA mode.

The following procedure illustrates this and demonstrates how to change the operation of a modem operating in SCPC mode back to STDMA mode.

Figure B-16 shows the STDMA page for the CDM-570/570L set up to run in Entry Channel mode.

Note: Refer to the Vipersat SLM-5650A modem manual for Entry Channel configuration setup. The text referenced within is similar between the CDM-570/L and the SLM-5650A; the UI page appearances may differ, however.

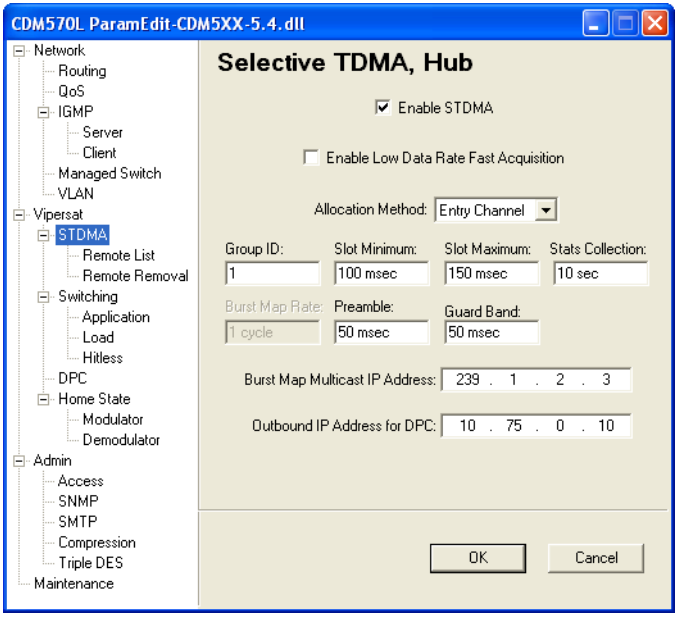


Figure B-16 STDMA Page with Entry Channel Mode, CDM-570/570L

Switching an ECM Remote from SCPC to STDMA

Use the following procedure to switch an ECM Remote operating in SCPC mode back to STDMA mode.

Note: This switch must be performed manually.

1. Click the **Remote List** menu item on the **STDMA** page shown in figure B-16 above to display the **STDMA Remote List** shown in figure B-17.

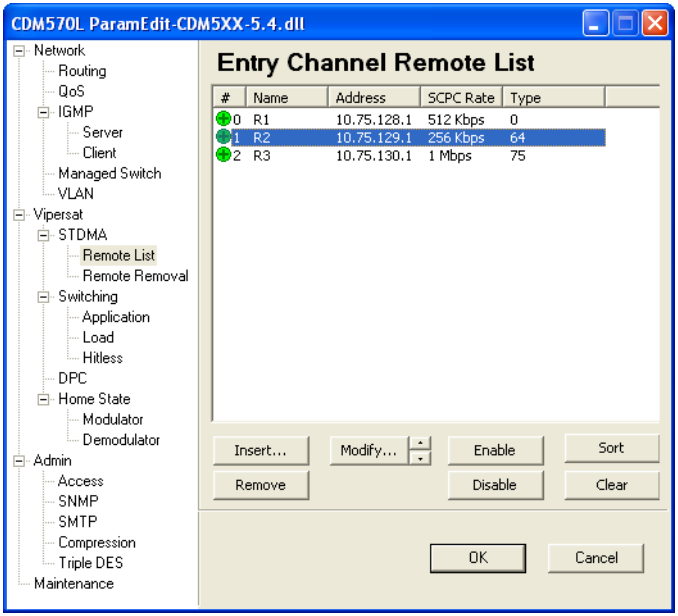


Figure B-17 ECM Remote List Page, CDM-570/570L

2. From the **STDMA Remote List**, select the Remote modem unit to be switched from running in SCPC to STDMA mode. Use the up and down arrows next to the Modify button to change the selected Remote.

3. Click the **Modify...** button to display the **Remote Entry** dialog shown in figure B-18.

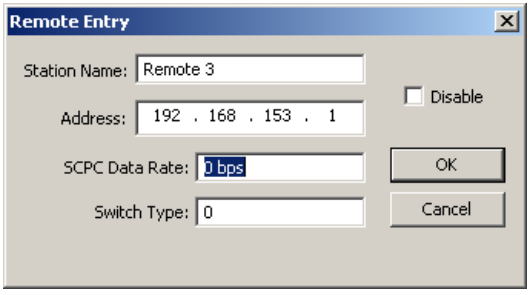


Figure B-18 Remote Bandwidth Entry, CDM-570/570L

4. To force a switch from ECM SCPC mode to STDMA mode, set the current value in the **SCPC Data Rate** dialog box to 0 (zero), then click the **OK** button.
Note that the 0 bps setting will cause the modem to remain in STDMA ECM

and not switch out to SCPC unless either an application switch occurs or a manual switch is invoked.

5. In VMS, right-click on the Remote as shown in figure B-19, then select the **Revert Uplink Carrier** command from the drop-down menu. The VMS will send the revert command to the target modem, causing it to revert to its STDMA home state.

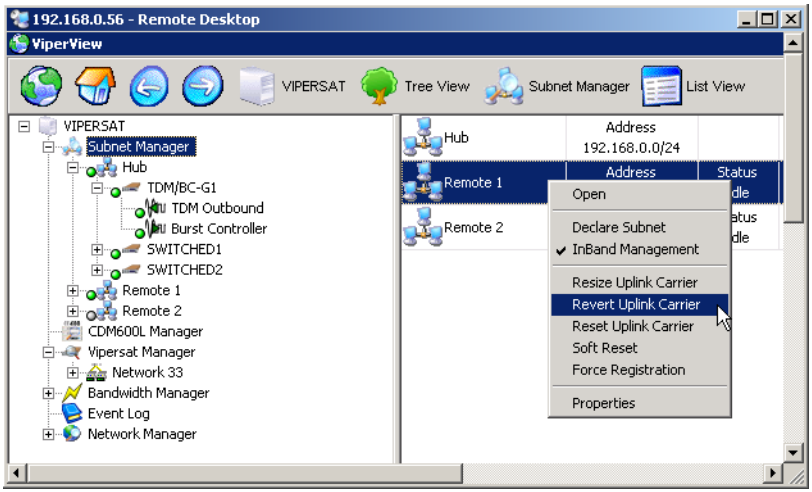


Figure B-19 Revert Uplink Carrier Command, VMS modem

This completes resetting the Remote modem to operate in the STDMA mode.

Dynamic Entry Channel Mode

Dynamic ECM (ECMv2) utilizes a modified slotted Aloha method for Remotes to establish registration in the network and obtain the means for switching into SCPC mode. Rather than sharing an STDMA burst map, as is the method with STDMA ECM, the Remotes rely on communicating with the Hub channel controller through the use of a multicast *Transmission Announcement Protocol* (TAP) message. This eliminates the restriction in the number of Remotes in an Entry Channel group that is inherent with the burst map method.

The TAP, broadcast periodically, supplies the Remotes with the transmit parameters that are required for transmitting back to the Hub. In addition, the TAP provides timing information in the form of slot parameters that define the

required acquisition time of the receiver and the amount of time allowed for M&C packet transactions.

All Remotes will receive the TAP message from the Hub, but a Remote will only transmit back to the Hub if it is a member of the specified group. Upon receipt of the TAP, the Remote resets its timing and uses the provided slot information to determine the next transmit opportunity. This allows each Remote to transmit at a discrete time to minimize the chance of collision. When a transmission to the Hub is not received, the Remote uses a random back-off (next slot) algorithm to further reduce contention, and will try again until a Hub response is received.

Upon valid reception of the Remote's transmission, the Hub channel controller will place the Remote into queue for assignment of switching into a *d*SCPC channel. The Remote will be registered in the VMS, then await the availability of the hardware and bandwidth resources necessary for execution of the switch request. The TAP will continue to be received even after the Remote has been switched out into SCPC.

Only management traffic is allowed while a Remote is in ECM. No data traffic is transmitted until the Remote is switched out of ECM and is operating in *d*SCPC mode.

Hub Configuration

The Hub channel controller is a dedicated demodulator that has been selected as an ECM controller. The Entry Channel configuration settings of this demodulator (figure B-20) determine the channel parameters that are transmitted in the TAP message and include:

- ECMv2 Enable
- Group ID
- TAP IP Multicast Address
- Preamble
- Guard Band
- LNB LO Frequency
- Satellite Frequency Conversion
- Total Slot Count

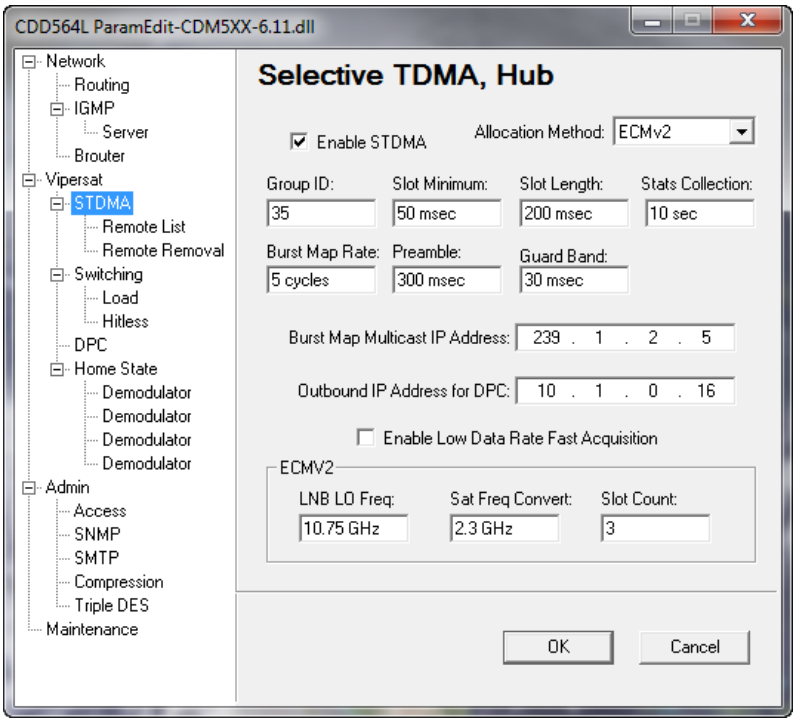


Figure B-20 Entry Channel Mode v2 Configuration, Hub (CDD-564L)

Remote Configuration

The demodulator (receive) configuration of each Remote in the group must be set appropriately in order to receive the TAP from the Hub. Because the TAP provides the necessary transmit parameters for the Remotes, manual modulator configuration by the operator is unnecessary. The Entry Channel configuration of the Remote (figure B-21) must include:

- ECMv2 Mode (Online, Wait, Offline)
- Group ID
- TAP IP Multicast Address
- BUC LO Frequency

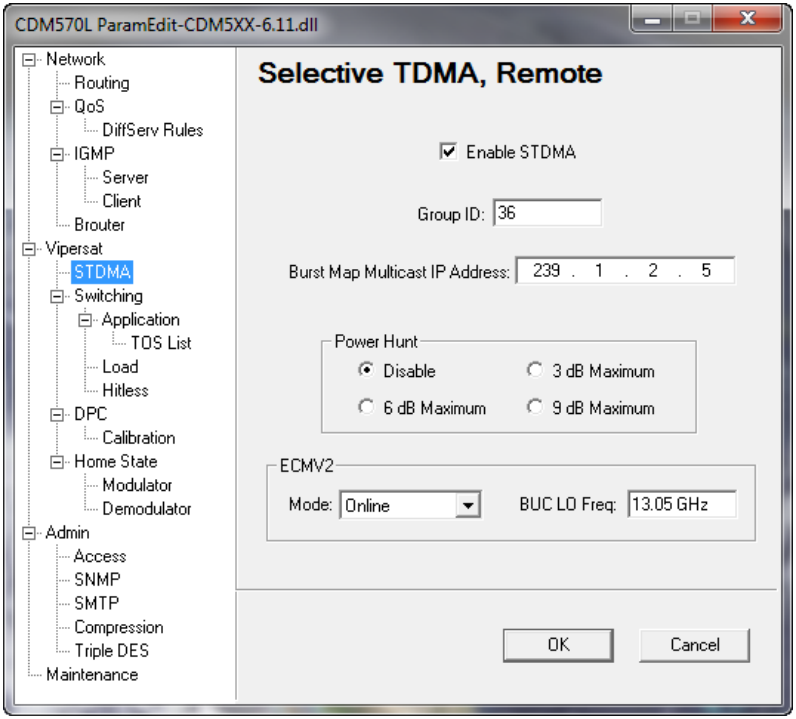


Figure B-21 Entry Channel Mode v2 Configuration, Remote (CDM-570L)

ECM Processing

A detailed representation of the sequence of steps that occur between the Hub units (the channel controller and a switched demodulator), the Remote unit, and the VMS during the ECM process is shown in figure B-22.

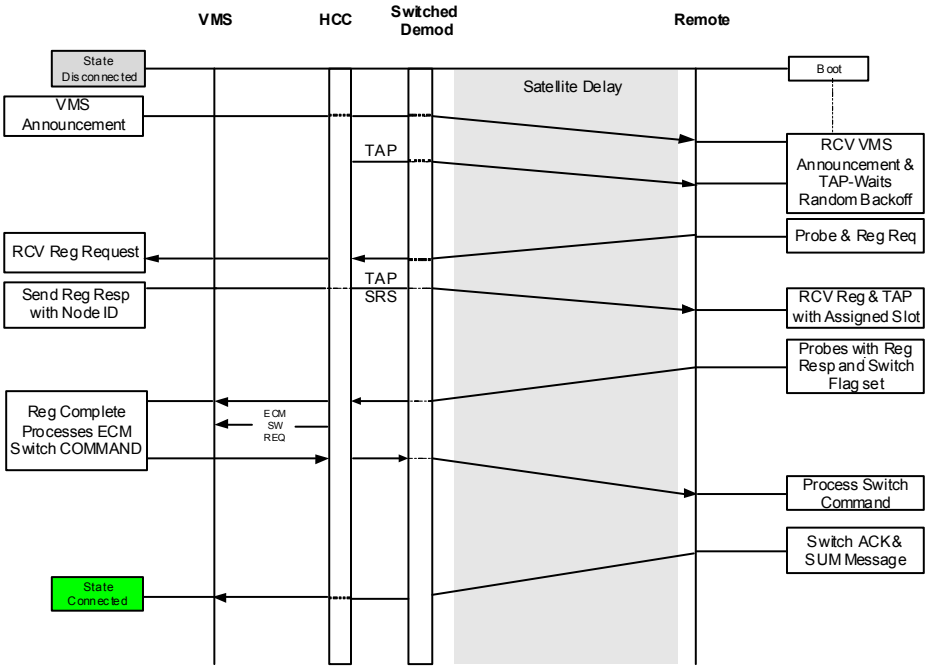


Figure B-22 ECMv2 Processing Diagram

{ *This Page is Intentionally Blank* }

APPENDIX

C

DYNAMIC POWER CONTROL

Introduction

Dynamic Power Control (DPC) provides a mechanism whereby Vipersat satellite links have their transmit power levels adjusted in order to optimize the receive signal quality, as measured by the corresponding demodulator E_b/N_0. This optimization process acts to either increase or decrease transmitted signal levels in order to:

- Achieve a minimum level of received E_b/N_0 consistent with providing an error-free link.
- Reduce transmit power where sufficient link margin exists in order to optimize station uplink and satellite transponder power usage, and reduce costs.
- Increase link availability when margins apply (typically Ku-band).

DPC can be selectively enabled and disabled on a unit-by-unit basis and functions as both a point-to-point and a point-to-multipoint control. DPC relies on the passing of an IP message between the receive site, where the receive quality is being measured, and the transmit site, where the power level is to be adjusted. These DPC packets are IP unicast messages, directed to the transmit site as forwarded from the corresponding dynamically assigned demodulator(s).

The Vipersat-optioned CEFD modem units have an algorithm that, when activated, automatically adjusts the modulator transmit power to maintain a constant nominal receive signal quality (E_b/N_0) at the corresponding receive site(s). This provides a mechanism to compensate for varying signal levels

caused, for example, by the use of different antenna sizes in a mesh network, or by rain fade conditions. Receive signal quality and use of system resources is optimized, resulting in a reduction in power amplifier intermodulation as well as conservation of satellite transmit power.

The power control algorithm is a closed loop servo-mechanism with the received E_b/N_0 values as the input function and the modulator transmit power as the output function. Only modulator transmit power is controlled by the algorithm since the transmit up-conversion chain is typically a fixed gain block. DPC can be applied to any or all of the modems, with the exception of the STDMA burst control demodulators. Since the STDMA burst demodulators are SCPC fast acquisition receivers, they cannot provide stable signal quality measurements (E_b/N_0). This value is critical in closing the power loop control mechanism.

Note: The power control function for a DPC-enabled unit is active only when that unit is operating in SCPC mode, and is inactive when operating in STDMA mode.

Description

The behavior of the Dynamic Power Control feature is designed to regulate power by utilizing the uplink margin to limit the maximum effective transmitted power ($EIRP_C$) of the terminal. The DPC function in the IP-enabled Vipersat-optioned modems provides controls allowing an operator to input site budget numbers that compensate and limit modulator output power. This power is based on link margin and maximum transmission parameter settings (*Data Rate*, *Modulation*, and *Code Rate*), as referenced to Home State base configurations.

The starting point for all enabled modulators is the Home State *Power Level*. This modulator output power is applied during initial system startup and is the baseline power at which the remote site will initially transmit. The modulator will continue to transmit at the baseline power as long as the site remains in STDMA mode.

When the modem is switched out of STDMA mode and into SCPC mode, the modulator will begin to receive DPC packets from the allocated demodulator (DPC must be enabled on both ends of the link). The packets are unicast to the modulator via the IP address. Once the packet is received, the modem then compares the received E_b/N_0 value to the stored value, immediately trimming the transmit power level accordingly. Depending on whether the received value is low or high, the modulator transmit output level is adjusted up or down until the E_b/N_0 meets the defined target for no power adjustment.

If the received E_b/N_0 should, for any reason, fall below a minimum value set by the *Speed Up Eb/No* parameter, then the DPC messages will be transmitted at a faster rate until the nominal level is restored.

BER Waterfall Mapping

DPC *Target Eb/No* values are automatically adjusted using the higher order modulation BER waterfall curves. These BER curves, as defined by the modem specifications, provide greater accuracy of the DPC function throughout all TPC modes. The compensated calculations are based on the received VMS multi-command message for an SCPC switch that configures the frequency, power, bit rate, modulation, and code rate. If the configuration differs from the base settings as compared to the BER table, the Target E_b/N_0 is modified to sustain an acceptable bit performance over all possible waveform configurations.

Delta Power Compensation

When DPC is adjusting power because of environmental conditions, such as rain fade, the adjusted power becomes a delta *DPC Offset* from the *BaseLine Power* parameter setting. This offset is applied to any power value received through remote dynamic switching commands. Briefly described, any DPC

Offset adjustments to the modulator transmit power during rain fade conditions are applied to incoming switch commands from the VMS. This prevents possible link failures due to power value changes associated with changes in bandwidth, modulation, etc.

In more detail, the *BaseLine Power* obtains its value from either the Home State Power Level setting or the power given to the modem by the VMS during the last switch command. At boot-up, and prior to receiving switch commands from the VMS, this parameter will match the *Nominal Power Level* value. If a DPC adjustment occurs due to changes in environment or other factors, the adjustment will appear in the *DPC Offset*, and will remain until environmental conditions change or a unit reset occurs. The resultant modem power will be the combined sum of the *BaseLine Power* and the *DPC Offset*.

Example

A Remote modem has the home state bit rate set at 128 kbps, with a BaseLine Power value of -15 dBm. When the VMS sends a switch command for a new bit rate of 256 kbps, it will send a corresponding power value of -12 dBm (new BaseLine) to compensate for the additional energy required to maintain C/N.

If, prior to a switch, a fade condition causes the power to increase by 2 dB at the home state bit rate, the resulting modem power will be -13 dBm, creating a DPC Offset value of 2 dB. Now when the VMS sends a switch command to 256 kbps, the modem power will be adjusted to -10 dBm (-12 dBm plus 2 dB). This prevents loss of the link due to power value changes based on fade conditions.

This feature is automatic and requires no operator involvement.

Theory of Operation

DPC is referenced from the commissioned Home State settings (*Data Rate* and *Modulator Power Level*). The Home State calibration point relies on the basic antenna commissioning procedures and relative link budgetary numbers. After antenna alignment, the base (clear-sky) modulator power output is adjusted to achieve the desired BER (E_b/N_0), typically while operating in switched SCPC mode at the base rate. This commissioned power and the data rate make up part of the Home State parameters which determine the *BaseLine Power* value that is also set and matched in the VMS site policies.

The Max Power value is converted to power *Margin* control. This positive integer sets the upper limit on any data rate, modulation, and code rate, only allowing power increases per the site Margin level. The example below, figure C-1, shows the Max Power levels for a range of data rates from 64 kbps to 4.096

Mbps. With a set margin of 5 dB, the additive power is never greater than the set level at any rate, but still provides a full range of power, up to the site maximum.

Dynamic Power Control						
64000	Home State nominal DR (bps)					
-27	Home State nominal power (dB)					
5	Margin (dB) or Relative Power Allowance					
Max DR (bps)					New Nominal (dB)	Max Power (dB)
64000	-0.5	1	0	-0.5	-27.1	-22.1
128000	0.5	2	0.30103	30.6029996	-23.9	-18.9
256000	0.5	4	0.60206	60.7059991	-20.9	-15.9
512000	0.5	8	0.90309	90.8089987	-17.9	-12.9
1024000	0.5	16	1.20412	120.911998	-14.9	-9.9
2048000	0.5	32	1.50515	151.014998	-11.9	-6.9
4096000	0.5	64	1.80618	181.117997	-8.9	-3.9

Figure C-1 Data Rate to Power Relationship, DPC

Note that only base rates are used in this example, with no alternative modulation or code rates.

Margins are very important because they are used to compensate for rain attenuation which could be as severe as 8 dB in Ku-band frequencies. The value of the uplink margin depends on the availability numbers set for the link. It should be noted that the E_b/N_0 defines the link quality threshold (target), whereas the margin defines the link availability. The dynamically controlled margin servomechanism, tracking the target E_b/N_0, allows the link to operate with calculated quality during clear-sky, adjusting higher during impaired conditions or lower if satellite EIRP or link gain increases. When link gain increases, the DPC has full range to decrease the power to the hardware lower limit, -40 dBm (L-band), -25 dBm (IF).

Additionally, the system is required to cap or limit the site to never exceed the budgetary power. To prevent the use of excessive power (past the saturation point) that will drown out the signal and possibly cause damage to the satellite, the modulator calculates a maximum power value for transmit. This control is accomplished with the DPC command line calculator that determines the maximum achievable budgeted power ($EIRP_C$) for the site. This menu driven calculator (Telnet/CLI and WSI only) allows an operator to enter site budgetary numbers (DPC Margin, Max Data Rate, Max Code Rate, Max Modulation, and Max FEC Type) to determine if the calibrated modulator base value output can achieve the maximum power range, while also limiting the site to the calculated overall Max Power.

The Max Power calculator takes into consideration all the above variables and compares them to the modem BER waterfall curves to determine if the modulator range is sufficient to achieve the budgetary information. If the calculator returns an error [INVALID], the base level is either too high or the set parameters have exceeded the capacity of the equipment.

Warning: The DPC maximum power setting is NO substitute for not configuring the site maximum transmission parameters—bit rate, modulation and power—in the VMS to match budgeted numbers. During dynamic switching commands, the VMS could override DPC limitations, if allowed. All commissioning settings for the site should be matched in the VMS to prevent over-ranging of the DPC maximum set points. See the *VMS User Guide* for site limit settings.

Many variables come into play when calibrating the base value, modem output range, entrance link cable runs (length vs. attenuation), high power amplifier conversion gains, and link budget calculations. Example: if the base data rate value is 64 kbps calibrated to -15 dBm, and the site budget number was 1024 kbps, the resulting modulator Max Power value would surpass the hardware limit (0 dBm, L-band), diminishing the margin efficiency by 2 dB, as shown in figure C-2.

Dynamic Power Control						
64000	Home State nominal DR (bps)					
-15	Home State nominal power (dB)					
5	Margin (dB) or Relative Power Allowance					
Max DR (bps)					new nominal (dB)	Max Power (dB)
64000	-0.5	1	0	-0.5	-15.1	-10.1
128000	0.5	2	0.30103	30.60299957	-11.9	-6.9
256000	0.5	4	0.60206	60.70599913	-8.9	-3.9
512000	0.5	8	0.90309	90.8089987	-5.9	-0.9
1024000	0.5	16	1.20412	120.9119983	-2.9	2.1
2048000	0.5	32	1.50515	151.0149978	0.1	5.1
4096000	0.5	64	1.80618	181.1179974	3.1	8.1

Figure C-2 Excessive Max Power Example

If the gain in the HPA is increased or the cable length/attenuation is reduced, the modulator output could be decreased by 3 dB or more and the site could achieve the max rate with a 1 dB site margin to spare.

Note: When configuring the site for Max Data Rate, the system operator must test (commission) the antenna at the max rate to ensure that the relative leveling of the uplink power does not exceed the 1 dB gain compression

point of the HPA. *See "Signal Power Level Considerations" on page C-15 for more information*.

Configuration

The DPC menus (CLI, Parameter Editor, WSI) provide configuration and calibration control to set up the site maximum power level. Note, however, that the Parameter Editor and the WSI only support a subset of what is available in the Command Line Interface (CLI). The DPC menu items are divided into two parts, the maintenance parameters (*DPC Main Menu*, table C-1) and the calibration parameters (*Calculate Max Power Menu*, table C-2).

Table C-1 and table C-2 show the complete list of the operational parameters for DPC.

Table C-1 DPC Parameters, Main Menu

Parameter	Menu	Default	Description
DPC Enable	Main; Modulator, Demodulator	Disabled	Modulator/demodulator DPC feature control; must be Enabled on both ends of link to operate.
Max Power	Main; Modulator	Display Only	Maximum transmit power level permitted; system-calculated site budgetary number.
Calculate Max Power	Main; Modulator	Sub-Menu	Select to enter *Calculate Max Power* menu.
Target Eb/No	Main; Modulator	10.0 dB	Target E_b/N_0 value for which DPC is aiming; static setting on modulator, dynamic on assigned demodulator(s).
Speed Up Eb/No Range	Main; Modulator, Demodulator	5.0 dB	DPC process speeded up from default (30 sec interval); if E_b/N_0 is outside the range, interval is reduced to 10 sec.
Target DPC (IP) Address	Main; Modulator, Demodulator	0.0.0.0	Identifies the modem that is transmitting to this device and will receive E_b/N_0 values. All InBand systems should remain default (not defined).
BaseLine Power	Main; Modulator	Display Only	Either the Home State Power Level setting, or the power given to the modem by the VMS during the last switch command.
DPC Offset	Main; Modulator	Display Only	The difference between BaseLine Power and adjusted SCPC power control.

Table C-1 DPC Parameters, Main Menu

Parameter	Menu	Default	Description
SOTM Offset	Main; Modulator	Display Only	Satcom-On-The-Move hunt power adjustment when operating in STDMA mode. When enabled, this offset value is applied to the BaseLine Power when switching into SCPC mode. *Used for Roaming feature*.
Margin	Main; Modulator	Display Only	The site power margin as used in Max Power calculation. *See Calculate Max Power for more details*.

Table C-2 DPC Parameters, Calculate Max Power Menu

Parameter	Menu	Default	Description
Calibrated Data Rate	Calculate Max Power; Modulator	Display Only	The Home State or base value Data Rate from initial configuration and commissioning.
Nominal Power Level	Calculate Max Power; Modulator	Display Only	The Home State or base value Power Level from initial configuration and commissioning.
DPC Margin	Calculate Max Power; Modulator	5.0 dB	The site power Margin given by the calculated link budget, used to provide adjustment in clear or diminished conditions.
Max Data Rate	Calculate Max Power; Modulator	1024000 bps	The site maximum Data Rate given by the calculated link budget, used to provide stop limit adjustment in clear or diminished conditions. *See modem specifications for valid range*.
Max Code Rate	Calculate Max Power; Modulator	Rate 3/4	The site maximum Code Rate given by the calculated link budget, used to provide stop limit adjustment in clear or diminished conditions. *See modem specifications for valid range*.
Max Modulation	Calculate Max Power; Modulator	QPSK	The site maximum Modulation given by the calculated link budget, used to provide stop limit adjustment in clear or diminished conditions. *See modem specifications for valid range*.
Max FEC Type	Calculate Max Power; Modulator	Undefined	The site maximum FEC Type given by the calculated link budget, used to provide stop limit adjustment in clear or diminished conditions. *See modem specifications for valid range*.

Table C-2 DPC Parameters, Calculate Max Power Menu

Parameter	Menu	Default	Description
Calculate Max Power	Calculate Max Power; Modulator	Calculate Command	After entering all maximum budgetary settings, this menu command will generate the Max Power value for the modulator.
Max Power	Calculate Max Power; Modulator	Display Only	The calculated modulator maximum Power at all maximum settings (Data Rate, Code Rate, Modulation, FEC Type). Controls upper limit of modulator output power.

Main DPC Menu

The main menu provides the basic configurable parameters: Enable DPC, Target Eb/No, Speed Up Eb/No Range, and Target DPC Address. Each of these main menu parameters are configurable from either the CLI or the Parameter Editor, as shown in figure C-3 and figure C-4.

For simplicity, only CDM-IP menus are shown.

When using the CLI, select **Dynamic Power Control** from the main Vipersat Configuration menu. When using the Parameter Editor, click on **DPC** from the tree list.

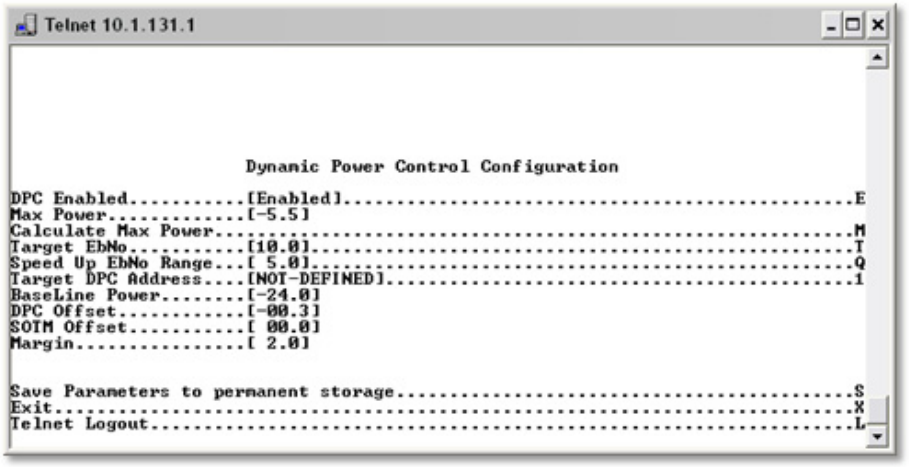


Figure C-3 DPC Configuration screen, CLI

As can be seen, the Maximum Power is display only. The Margin is also display only, as shown in these two figures. These parameter settings can only be

changed from the CLI Calculate Max Power menu (figure C-5). The calculator function is not available from the Parameter Editor because it does not contain the information for the modem BER waterfall curves, which is vital to calculate maximum power. Consequently, the Parameter Editor provides display-only values for the maximum settings from when the parameter file was acquired from the modem. Thus, this dialog (figure C-6) is labeled DPC *Calibration* rather than Calculation.

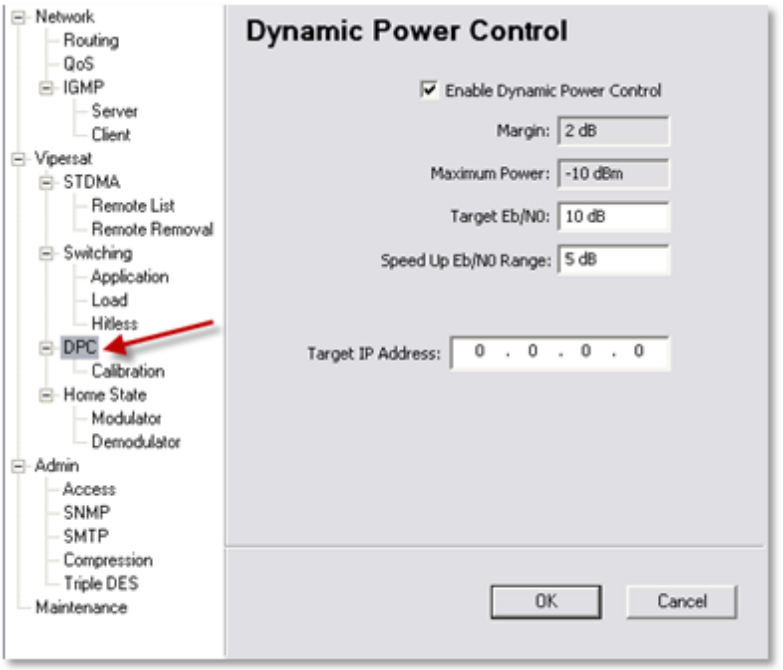


Figure C-4 DPC dialog, Parameter Editor

Enable DPC

When implementing the DPC function, it is necessary to enable DPC for each modem that will utilize this feature and any of the corresponding demodulator devices that it may link with, as the function is a peer-to-peer protocol.

Target Eb/No

The Target Eb/No value is entered as defined in the site link budget calculations and provides the desired signal strength for the DPC process, which is a closed loop servomechanism. The modulator closed loop servomechanism relies on an IP packet (message) that is generated by the corresponding receiving demodulator (distant end), is sent every 30 seconds, and contains a processed E_b/N_0

carrier value. When this value is received by the transmitting modulator, it is compared to the set value; if they are different, the modulator servos its output power level to achieve the targeted E_b/N_0 level.

The modulator DPC function can support multiple demodulators as assigned by the system. As each active demodulator is assigned, a separate DPC message is received invoking the modulator process to add the demodulator to a list, which is then scanned to determine the worst case demodulator. After each scan, the demodulator with the lowest E_b/N_0 is posted for the next DPC power servo cycle. This process is repeated upon reception of each demodulator DPC message. The list is renewed every 65 seconds and if, for any reason, a demodulator fails to respond during active cycles, it is removed from the list.

Speed Up Eb/No Range

Normally, the DPC message is sent every 30 seconds from the corresponding receiving demodulator(s) in the network. The *Speed Up Eb/No Range* is a window value centered on the modulator set Target Eb/No value. However, the demodulator does not have a user settable target value; it would be impossible to predetermine this value for active demodulators, as they are dynamically assigned during switch setup. On the flipside, the modulator does have this value and, upon reception of the first DPC message from the corresponding demodulator(s), it sends a message back to the demodulator for setting the Target Eb/No value.

Now, if the measured demodulator E_b/N_0 value falls outside the window range, the demodulator DPC process will increase the message interval rate to every 10 seconds until the measured value is back within the set range.

Target DPC (IP) Address

In a standard Vipersat network where the modems are being used as switched InBands, the VMS handles the assignment of the target IP address for the receive units. When a remote is switched into SCPC mode and DPC is enabled, the VMS writes the corresponding modulator IP address into the allocated demodulator, hub or remote. This particular control is reserved for Out-of-Band devices only, because in this case the system does not automatically assign this target address. *This entry is left as default 0.0.0.0 for dynamic SCPC usage.*

Calculate Max Power Menu

Using the CLI, selecting *Calculate Max Power* from the DPC Main menu will present the Calculate Max Power menu, as shown in figure C-5. Note that the Parameter Editor presents the calibrated values for visual reference only, as shown in figure C-6, and does not provide the calculate function.

This calculator uses the site budgetary numbers to determine the maximum power value when operating at peak transmission settings. After the operator enters all parameters and selects the *Calculate Max Power* command, the calculator compares the values to base numbers and selected BER tables to determine the power budget based on the total margin.

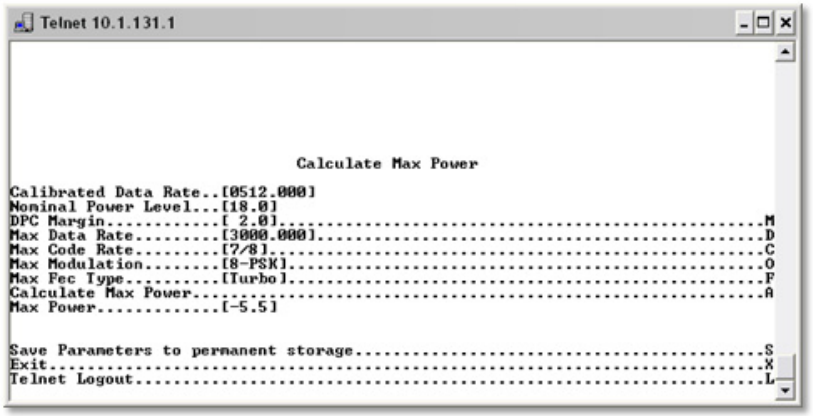


Figure C-5 DPC Calculate Max Power screen, CLI

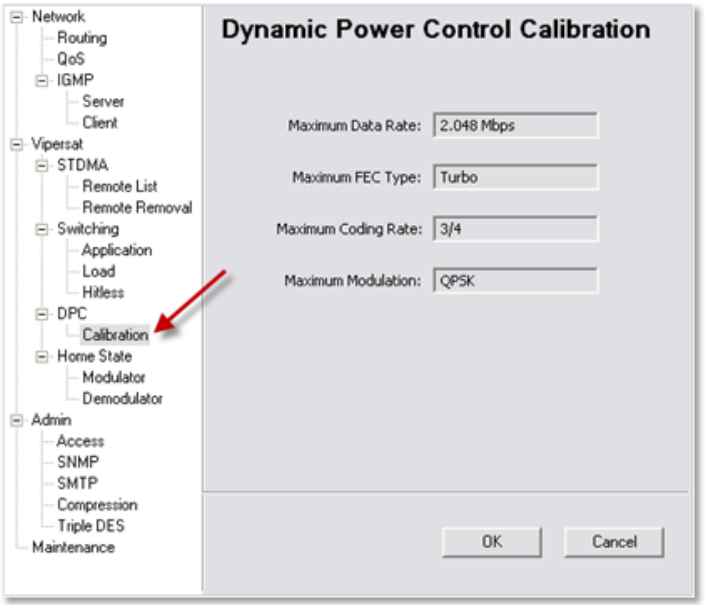


Figure C-6 DPC Calibration dialog, Parameter Editor

Calibrated Data Rate

This is the Baseline Home State Data Rate and is used as the base reference value to calculate the maximum DPC Margin.

DPC Margin

The Margin setting governs the upper power limit for all combinations of waveforms given.

Nominal Power Level

This is the Baseline Home State modulator Power Level and is used as the base reference value to calculate the maximum DPC Margin.

Max Data Rate

This is the Maximum Data Rate achievable as calculated through site budgetary numbers.

Max Code Rate

This is the Maximum Code Rate achievable as calculated through site budgetary numbers.

Max Modulation

This is the Maximum Modulation achievable as calculated through site budgetary numbers.

Max FEC Type

This is the Maximum FEC Type achievable as calculated through site budgetary numbers.

Calculate Max Power

This is the command to generate a maximum achievable modulator site power as calculated using each of the budgetary numbers. If the entrance link cabling attenuation and High Power Amplifier gain variables are balanced, the calculation will return a modulator output value within equipment limits. If any one of these uplink variables is under or over, the returned value will display INVALID.

S*ee "Signal Power Level Considerations" on page C-15 for more information.*

Max Power

After entering all site budgetary numbers and selecting the Calculate Max Power command, the system processes the max settings against the BER tables to determine and display the site maximum power limit. This maximum power value is achieved only when all parameters are dynamically set to maximum and the environmental conditions are at diminished capacities.

Signal Power Level Considerations

There are many parameters to consider when planning and commissioning a site for satellite transmission. Among the most important are selections for location, antenna size, and High Power Amplifier. Do not forget entrance link cabling. These pre-selections determine maximum operability of the site in freedom of range and limitations. Uplink power gain limitations and cable losses are the main focus of this section.

The following sub-sections describe the basic segments in adjusting uplink gains to properly achieve a balance between minimum and maximum transmission throughputs.

The example block diagram shown in figure C-7 represents a typical remote station with relevant signal power levels in the transmit and receive chain.

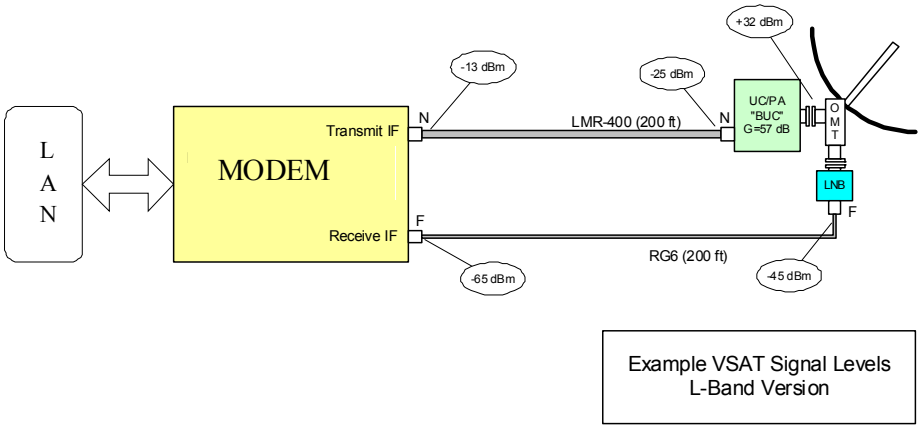


Figure C-7 Signal Power Levels, Remote Site

There is virtually no control over the receive signal levels short of setting the antenna size, as the demodulator uses a sliding AGC window with an approximate AGC range of 55 dB at any given data rate.

However, the transmit levels must be carefully controlled. Most BUCs have no internal gain control and therefore represent a fixed gain block. The output power is thus directly proportional to the input level, up until the amplifier is driven to its 1 dB gain compression point (P1dB), beyond which the output level no longer increases (nonlinear). Some types of amplifiers (such as TWTs) will actually result in a lower output level as the input is increased. What is important, therefore, is to know the maximum input level of the BUC, or the gain and P_{out} at the 1 dB compression point. The maximum modulator output

level is then calculated based on the BUC's P_{in} max minus the transmit cable loss.

The levels shown in the example above assume a transmit cable loss of about 12 dB. Apply this calculated value to the returned Max Power value to determine if *one*, the maximum power is within gain/loss limits and *two*, the total range is achievable.

Power Considerations

The amount of power is defined by the link budget. As a rule of thumb, there should be at least 2 dB of headroom (margin) left when operating at the highest bit rate that the remote is expected to transmit at C-band. Ku-band should typically have 5 or 6 dB of headroom to compensate for rain fade. Transmission equipment works best when it is operated mid range. Typically, any BUC larger than 8 W will need an external power supply.

Cabling Considerations

L-band frequencies are much more susceptible to signal loss over cable runs than IF frequencies in the 70/140 MHz range. For example, RG214 is commonly used for IF frequency runs. At 70 MHz, the loss per 100 ft of cable is approximately 1.7 dB. However, at 1.2 GHz (L-band), the loss is more than 8 dB. A higher quality cable such as LMR400, which exhibits approximately 4.5 dB of loss per 100 feet, is recommended. Note, however, that in some cases—such as short cable runs—additional losses may be required to maintain that balance between min/max ranges.

It is much simpler to add/subtract excess cable to increase/decrease losses for proper adjustment. The alternative of inserting an attenuator that can pass power to the BUC is considerably more expensive.

The transmit cable must carry a heavy current on the order of 1 to 5 amps to power the BUC/PA. The DC resistance and cable voltage drop must allow this gear to receive their minimum voltage, plus enough margin for variation with time and temperature.

The transmit and receive cables must be separated and definitely not bundled directly together with cable ties, especially on longer runs because of the tremendous difference between the transmit and receive levels. This is made worse on long cable runs because the modem end will have higher transmit levels and the receive end will have lower levels than on a short run. The better cables in this regard have double shielding (two braids or a braid/foil combination) and a shielding efficiency of 100 dB or better.

A good note here is that, with the typical LO frequencies as shown in the example above, transmit and receive L-band frequencies are widely separated. If the signals were within the LNB stability/drift frequency limits, there might be a tendency for the receive side to attempt locking to its own transmit signal.

Considering the L-band IF range is 950 MHz or more spanning close to an octave, the variation in loss between the high and low ends of the IF range may be significant.

A nominal design point may be to allow for 10 to 15 dB of total cable loss and select cable that will reliably achieve this. A more accurate “rule of thumb” would be to design for a total gain from the antenna to modem receive input of -40 dBm. For example, if the receive LNB has a gain of 60 dB and there are no other losses, then the cable can have a maximum loss of 20 dB (60 – 40 dB). In formula form this is:

Loss (cable max) = Gain (LNB) – 40 – Loss (misc) in dB

Or, for the transmit side, the cable loss should not keep the input to the BUC from reaching its Power input for 1 dB compression point. Arbitrarily allowing a 3 dB margin in the modem output, this formula would be:

Loss (cable max) = +3 – BUC Pin (1dB) – Loss (misc) in dB

Notice that this assumes no miscellaneous losses in the transmit or receive side, but there may be other losses such as from a splitter or output sample port, if used.

See table 6-1 below for typical cable characteristics (note that cable prices are estimates only).

Table C-3 Typical Coaxial Cable Characteristics

Cable Type	Max. Freq. (MHz)	O.D. (inch)	Loss/100 feet (dB) @1.2 GHz	Shielding Efficiency (dB)	Estimated Cost/ft. (USD)
RG58 (50Ω)	1,000	0.19	21.0	70	0.39
RG59 (75Ω)	1,000	0.25	18.0	70	0.39
RG6 (75Ω)	2.200	0.25	10.0	>90	0.89
RG11 (75Ω)	2.200	0.405	5.0	>90	0.89
Times LMR-240 (50Ω)	5,000	0.24	9.2	>90	0.47
Times LMR-300 (50Ω)	5,000	0.30	6.8	>90	0.53

Table C-3 Typical Coaxial Cable Characteristics

Cable Type	Max. Freq. (MHz)	O.D. (inch)	Loss/100 feet (dB) @1.2 GHz	Shielding Efficiency (dB)	Estimated Cost/ft. (USD)
Times LMR-400 (50Ω)	5,000	0.405	4.8	>90	0.64
Times LMR-600 (50Ω)	5,000	0.59	3.1	>90	1.30
Belden 9913 (50Ω)	5,000	0.405	5.2	>90	0.60
RG214 (50Ω)	5,000	0.405	10.1	>90	1.70
3/8-inch LDF (50Ω)	5,000	0.44	4.1	>90	1.89
½-inch Superflex (50Ω)	5,000	0.52	4.2	>90	1.89

APPENDIX

D

ECM MIGRATION

Migrating from STDMA/ECMv1 to Aloha/ECMv2 in a CDM-570/L Network

General

The material in this appendix is offered to provide a step-by-step procedure for network operators to migrate an STDMA/ECMv1 control channel to the latest version of Aloha/ECMv2. This new Entry Channel feature is based on modified slotted Aloha and differs from the current STDMA/ECM control protocol, but it does leverage some of the STDMA software foundation to support the feature changes.

The two ECM versions share common code from the point of STDMA feature enable, multicast IP address, group ID, preamble, and guardband settings. However, ECMv2 differs by providing the following:

Hub Control

- Hub Controller demodulator receive parameter set is propagated to all listening Remotes for auto-configuration of transmit parameter sets
- No list of Remotes required for control; offers unsolicited access
- Simple control channel carrier mobility

Remote Control

- Transmit carrier parameters controlled by Hub Channel Controller
- No customer data traffic sent while in Entry Channel mode; only M&C

All other standard controls for access into *d*SCPC are maintained, but because of a new fixed entry switch type, **VMS version 3.9.2** or greater is required.

Because most networks are likely to have Remote sites off-the-air for various reasons, the task of upgrading all locations during a planned maintenance period introduces complexity, particularly where the upgrade breaks current protocol. If this is the case, it will be required to provide additional resources during the migration to assure all sites—active or inactive—make the transition.

Sites that are active are much simpler to upgrade and modify, but sites that are inactive must have the old (current) hardware or configuration running to assure that an upgrade path is available when they reactivate.

These additional resources typically have at least one STDMA Burst Controller programmed for the inactive sites. This will assure that, when the Remote activates, it can enter the network as always and allow the operator to upgrade and migrate the site to the new ECMv2 channel.

Migration Procedure

This procedure is intended for Remote sites that are online or offline with Hub communications. The following steps are accomplished remotely through communication links from Hub to Remote site.

1. Save backup parameter configuration files for all of the Remotes. Store these files as current configuration to facilitate the option to fall back to STDMA ECM.

2. Upgrade firmware in all active Remotes that will participate in ECVMv2 operation to version 1.6.11 (or 2.6.11 for CDM-570 with version 2 hardware).

3. Add the supplied editor file (ParamEdit-CDM5XX-6.11.dll) to the VMS bin directory, which will allow proper editing response through the new GUI.

   Path *C:\Program Files (x86)\Vipersat\VMS\3.0\bin*

Configure Remote Units

There are two options for configuring the Remote units:

- From the Hub site, use the **Configure** command in the VMS ViperView interface. The use of this method is illustrated in this procedure.
- From the Remote site *with local access only*, use the **CLI** via either the Console port or Telnet.

  Note: **Do Not** attempt to execute this procedure using the CLI via remote Telnet (over the air). When using the CLI, the BUC LO frequency parameter can not be accessed until the ECMv2 Mode has been enabled first. However, enabling this feature will immediately initiate TAP communications and block the ability of the user to set the BUC LO value.

With the Remotes switched into *d*SCPC, configure each modem using the **STDMA** page, as shown in figure D-1.

1. Enter the **BUC LO Freq** parameter, making sure the units are set correctly.

   The BUC frequency is very important. This allows any frequency translation between Hub downlink and Remote uplink to properly match for inversions or offsets.

2. Enable ECMv2 by selecting **Online** mode.

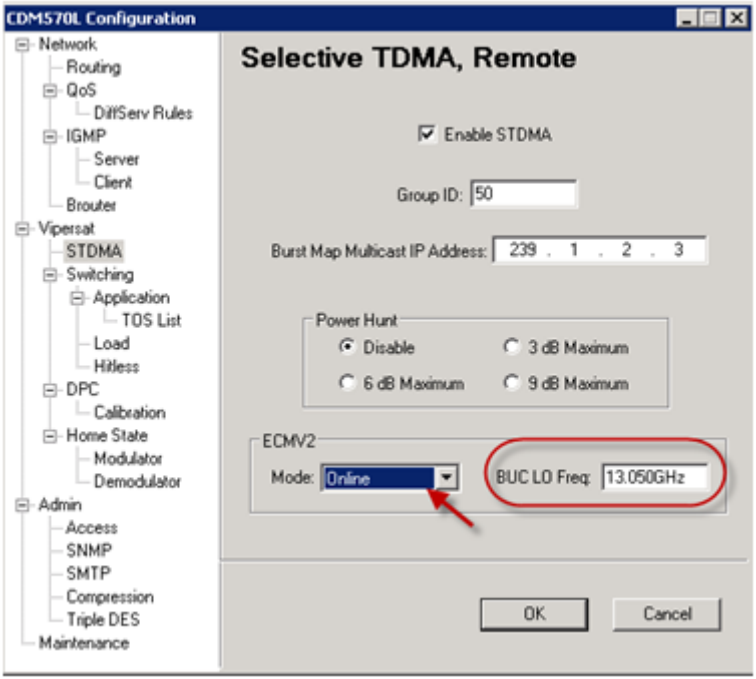


Figure D-1 STDMA Configuration Page, Remote CDM-570/L

3. Click on the **OK** button to implement the change, and **Save to Flash** when prompted to ensure that this new configuration is preserved during Hub configuration.

The new configuration parameters will be uploaded and the Remote will be forced to its Home State, awaiting new TAP messages. The transmit may be disabled during the time period for Hub reconfiguration.

Notice that the VMS will time out during the writing process (indicated with the progress bar). This is okay, as communications to the Remote modem will be temporarily lost.

4. Repeat the above steps for each Remote before proceeding with the Hub configuration.

Configure Hub Unit

Once all active Remotes have been configured to ECMv2/Online state, the next step is to configure the ECM Hub Channel Controller, which can be the demodulator on either a CDM-570 or a CDD-56X.

Caution: If a separate controller is in use while the current STDMA unit(s) are running, make absolutely sure that the **Group ID** is unique from what is currently configured in the running STDMA's. The multicast IP address can be the same; this is not a problem.

Ensure that the **Low Data Rate Fast Acquisition** feature is disabled.

Set the **Preamble** accordingly. *If unsure, contact CTAC for the correct value to match the active configuration*.

1. From the CLI Main Menu, navigate to **Vipersat configuration > STDMA Mode** screen.

2. Enter **T** at the command prompt for **Hub Type**, and then enter **6** to select **ECMv2** (figure D-2).

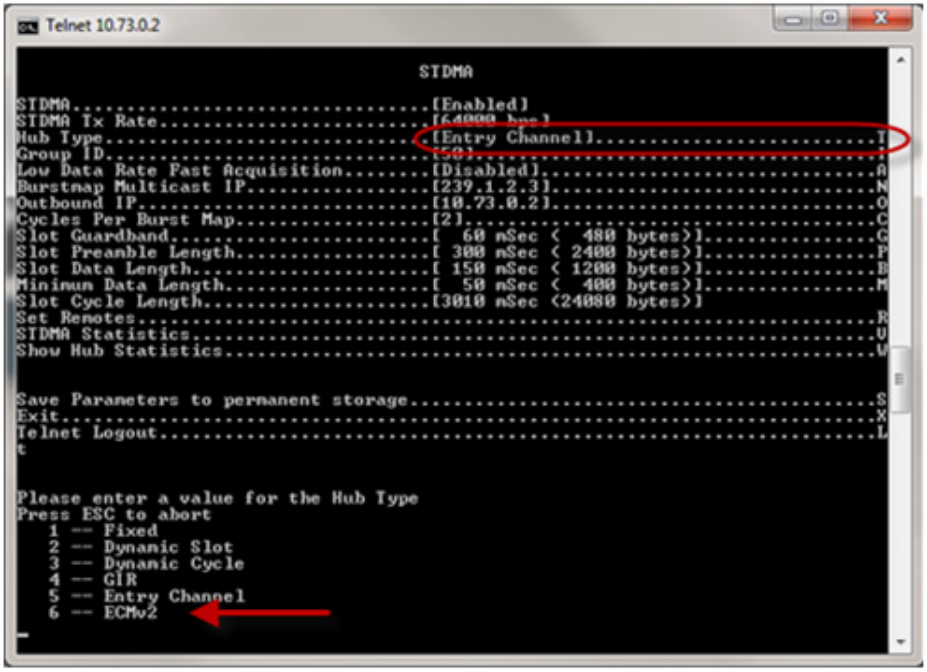


Figure D-2 STDMA Configuration Menu, Hub Type Selection

After the Hub Type is changed to ECMv2, the controller will start sending TAP multicast messages using the burst map multicast address 239.1.2.3, and broadcasting to the group the frequency, data rate, and timing as well as where and when the Remotes can transmit.

Note that the frequency value is sent in RF uplink format, so it is very important to set the Hub LNB LO Frequency as well as the Satellite Frequency Conversion parameter values in the STDMA menu (figure D-3).

3. Enter **Z** at the command prompt to specify the **LNB LO Frequency**.
   Enter **F** at the command prompt to specify the **Satellite Frequency Conversion**.

   These values should *NEVER* remain as zero (default).

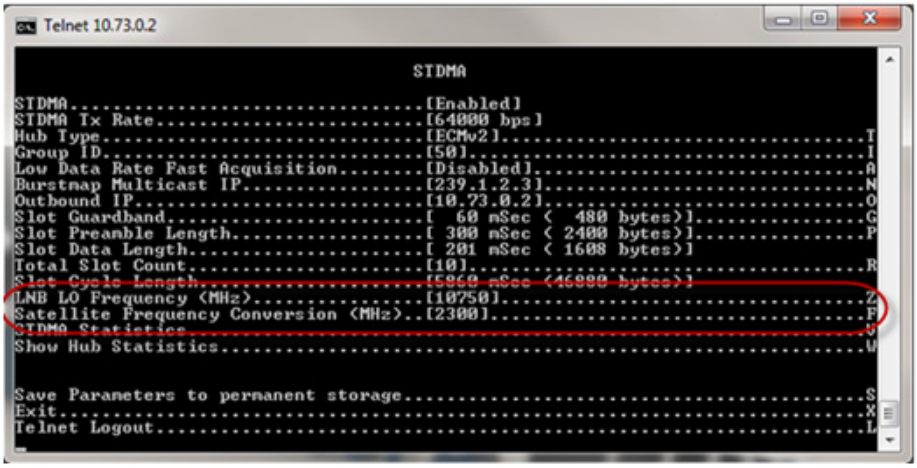


Figure D-3 STDMA Menu, ECMv2 Hub Type

At this point, the Remotes will start bursting in the new, temporary frequency or the same slot as the original STDMA channel. To move the ECMv2 slot, modify the Hub demodulator frequency or data rate for the desired new location.

One of the many advantages of ECMv2 is that the Remote modulator will no longer have to be configured; the modem will automatically update its Home State transmit parameters to match the ECMv2 slot as soon as it receives the next TAP message from the Hub.

It is recommended that the operator update and save the Home State on the Hub Controller to ensure that the parameters will remain during a reboot.

4. Adjust the ECMv2 calibration as necessary with the **Slot Guardband**, **Slot Preamble Length**, and **Total Slot Count** parameter settings.

Example: The recommended settings for 64 kbps, QPSK, 3/4

- Guardband—60 msec
- Preamble Length—300 msec
- Total Slot Count—10

Tip: A Vipersat calculator is available to optimize these settings. Contact a Comtech Vipersat Networks representative for a copy of the latest *Vipersat ECM Calculator*.

There is no *Remote List* for ECMv2 like there is for ECMv1. Therefore, there is no need to enable the Remotes in the burst map, nor to set a desired *d*SCPC switch rate.

With ECMv2, the Remote sites will switch out to *d*SCPC using the **Minimum Switch Rate Limit** from the **Inband Return Path** settings, as shown in figure D-4 below.

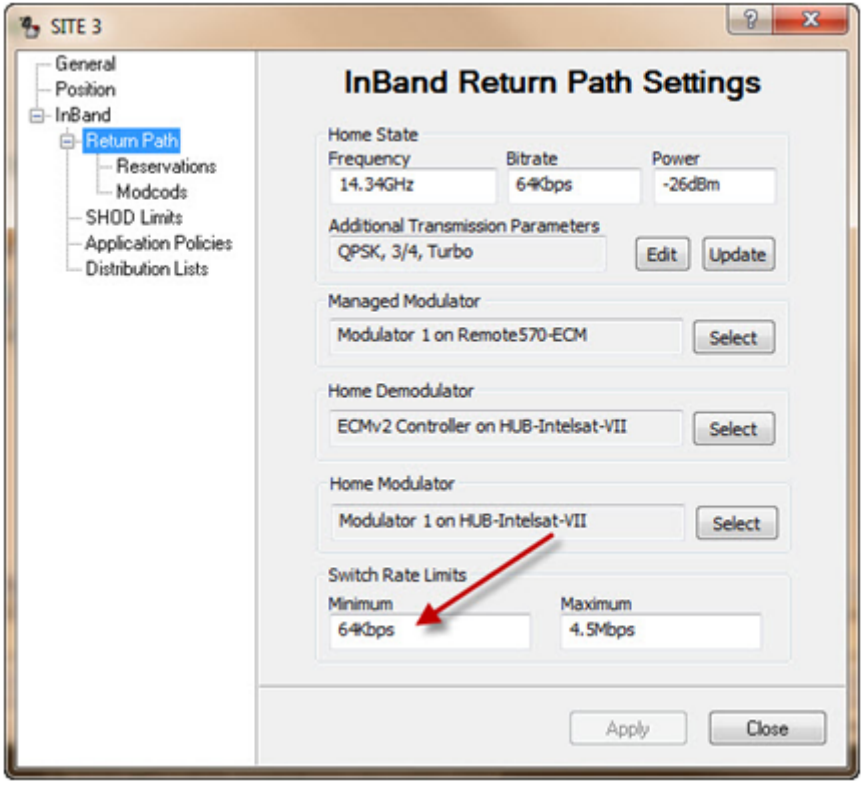


Figure D-4 Switch Rate Limits, InBand Return Path Settings Page

5. Save the configuration to Flash on the ECM Hub Controller.

This concludes the ECM migration procedure.

APPENDIX

E

GLOSSARY

A

ACK A signal used in computing and other fields to indicate **ack**nowledgement, such as a packet message used in TCP to acknowledge the receipt of a packet.

ACM **A**daptive **C**oding and **M**odulation – A technique that optimizes throughput in a wireless data link by adapting the forward error correction code rate and the modulation order according to the noise conditions (or other impairments) on the link. A feature that is supported in CEFD modems such as the CDM-840 Remote Router.

ARP **A**ddress **R**esolution **P**rotocol – A protocol for a LAN device to determine the MAC address of a locally connected device given its IP address. See also MAC.

ASR **A**utomatic **S**witch **R**equest – A switch request message generated by older Vipersat modems (e.g., CDM-570/L) that is sent to the VMS to establish a new satellite link or adjust bandwidth between source and destination IP addresses.

B

Base Modem The main component in a satellite communications modem that consistes of a circuit board with the modem hardware and firmware and the associeated interfaces.

BER **B**it **E**rror **R**ate (sometimes **R**atio) – A measure of the number of data bits received incorrectly compared to the total number of bits transmitted.

BPM **B**ridge **P**oint-to-**M**ultipoint – Routing mode option available in the SLM-5650A satellite modem.

bps **b**its **p**er **s**econd – A measure of the bit rate or transmission speed of a digital communication link. See also *kbps* and *Mbps*.

BPSK **B**inary **P**hase **S**hift **K**eying – Sometimes referred to as 2-PSK. A digital modulation technique in which the carrier is phase shifted +/-180 degrees (two phases). The simplest and most robust of all PSKs, but unsuitable for high data-rate applications when bandwidth is limited due to encoding just one bit per symbol. See also *QPSK* and *OQPSK*.

BUC **B**lock **U**p **C**onverter – An upconverter so called because it converts a whole band or "block" of frequencies to a higher band. The IF is converted to final transmit frequency for satellite communications. The BUC is part of the satellite ODU/transceiver.

C

C-band A frequency band commonly used for satellite communications (and sometimes terrestrial microwave). For terrestrial earth stations, the receive frequency band is 3.7–4.2 GHz and the transmit frequency band is 5.925–6.425 GHz. See also *Ku-band* and *L-band*.

CDD **C**omtech **D**ata **D**emodulator (CEFD model designator; e.g., CDD-564)

CDM **C**omtech **D**ata **M**odem (CEFD model designator; e.g., CDM-570)

CEFD **C**omtech **EF D**ata – Global leader in satellite bandwidth efficiency and link optimization, and supplier of advanced communication solutions. A subsidiary of Comtech Telecommunications Corporation.

CIR **C**ommitted **I**nformation **R**ate – A specified data rate up to which a remote terminal is always guaranteed to be granted service from reserved bandwidth in the shared pool.

CLI **C**haracter **L**ine **I**nterface – A mechanism for interacting with a computer operating system or software by typing commands to perform specific tasks.

Codecast A network coding based ad hoc multicast protocol well-suited for multimedia applications with low-loss, low-latency constraints. Because data is streamed with no verification, high delivery ratios are obtained with very low overhead.

CRC **C**yclic **R**edundancy **C**heck – A method of applying a checksum to a block of data to determine if any errors occurred during transmission over communications links.

CXR Carrier – A radio frequency transmission linking points and over which information may be carried.

D

DAMA **D**emand **A**ssigned **M**ultiple **A**ccess – A process whereby communications links are only activated when there is an actual demand.

dBm **D**eci**b**el referenced to 1 **m**illiwatt.

DES **D**ata **E**ncryption **S**tandard – A federal standard method for encrypting information for secure transmission. The Vipersat system offers 3xDES (Triple DES) for encrypting traffic.

DHCP **D**ynamic **H**ost **C**onfiguration **P**rotocol – An Internet protocol for automating the configuration of computers that use TCP/IP.

DLL **D**ynamic **L**ink **L**ibrary – The implementation of the shared library concept in the Microsoft Windows system.

DPC **D**ynamic **P**ower **C**ontrol

DSCP **D**ifferentiated **S**ervices **C**ode **P**oint – The 6-bit field in an IP packet header that is used for packet classification purposes and is the portion of ToS that is detected by Vipersat modems.

DVB **D**igital **V**ideo **B**roadcasting – A suite of internationally accepted open standards for digital television. DVB-S, DVB-S2, and DVB-RCS are the standards utilized by satellite services.

DVP **D**igital **V**oice **P**rocessor – Used in packet voice applications.

E

E_b/N_0 The ratio of $\mathbf{E_b}$ (energy per bit) and $\mathbf{N_0}$ (noise power spectral density per Hz). This is a normalized signal-to-noise ratio (SNR) measure, also known as the "SNR per bit". The bit error rate (BER) for digital data is a decreasing function of this ratio. E_b is the energy of an information bit measured in Joules or, equivalently, in Watts per Hertz.

E_s/N_0 The ratio of $\mathbf{E_s}$ (energy per symbol) and $\mathbf{N_0}$ (noise power spectral density per Hz). This is closely approximate to the carrier-to-noise ratio (C/N). E_S is the energy of a bit (not an information bit) measured in Joules or, equivalently, in Watts per Hertz. This measurement is typically used to quantify a DVB-S2 carrier.

ECM **E**ntry **C**hannel **M**ode – In a Vipersat network, ECM provides a quick and reliable method for Remotes requiring SCPC access channels to enter/re-enter the network initially or after a power or other site outage.

F

FAST Code **F**ully **A**ccessible **S**ystem **T**opology Code – Designation for feature code used by Comtech EF Data for their satellite modems. The FAST method makes it easy to quickly upgrade the feature options of a modem while it is running live in the network, either on site or remotely.

FDMA **F**requency **D**ivision **M**ultiple **A**ccess – A technique where multiple users can access a common resource (e.g. satellite) by each being allocated a distinct frequency for operation. See also *TDMA* and *STDMA*.

FEC **F**orward **E**rror **C**orrection – A process whereby data being transmitted over a communications link can have error correction bits added which may be used at the receiving end to determine/correct any transmission errors which may occur.

Flash Non-volatile computer memory that can be electrically erased and reprogrammed.

Forward Path Transmission path from the Hub site to a Remote site.

FTP **F**ile **T**ransfer **P**rotocol – An application for transferring computer files over the Internet. See also *TFTP*.

G

G.703 ITU-T standard for transmitting voice or data over digital carriers such as T1 and E1.

G.729 ITU standard for LD-CELP (Low Delay – Code Excited Linear Prediction) voice encoding at 8 kb/s.

GIR **G**uaranteed **I**nformation **R**ate

Group ID A number assigned to equipment which defines it as a member of a group when addressed by the VMS Hub Controller.

GUI **G**raphical **U**ser **I**nterface – A form of graphical shell or user interface to a computer operating system or software application.

H

H.323 A protocol standard for multimedia communications designed to support real-time transfer of audio (such as voice over IP) and video data over packet networks. Quality of Service is a key feature of H.323. An alternative to SIP.

HCC **H**ub **C**hannel **C**ontroller – A dedicated Hub demodulator that has been designated as the ECM (ECMv2) controller, and which provides the TAP multicast message to the Remotes.

HDLC **H**igh Level **D**ata **L**ink **C**ontrol – A standard defining how data may be transmitted down a synchronous serial link.

HPA **H**igh **P**ower **A**mplifier – The amplifier used in satellite communications to raise the transmit signal to the correct power level prior to transmission to satellite.

HTTP **H**yper **T**ext **T**ransfer **P**rotocol – The Internet standard for **W**orld **W**ide **W**eb (**WWW**) operation.

Hub The central site of a network which links to a number of satellite earth sites (Remotes).

I

ICMP **I**nternet **C**ontrol **M**essage **P**rotocol

IDU **Ind**oor **U**nit – In a VSAT system, the satellite modem is referred to as the IDU.

IF **I**ntermediate **F**requency – In satellite systems, IF frequencies are usually centered around 70/140 MHz (video/TV), or 1200 MHz (L-band).

IFL **I**ntra-**F**acility **L**ink – The coaxial cabling used to connect the satellite ODU to the IDU. Carries the inbound and the oubound signals, and the 24 VDC for the LNB.

IGMP **I**nternet **G**roup **M**anagement **P**rotocol – An IP communications protocol used by network hosts and adjacent routers to establish multicast group memberships.

Image A binary firmware file that provides the operational code for the processor(s) in a network unit.

IP **I**nternet **P**rotocol – A format for data packets used on networks accessing the Internet.

ISP **I**nternet **S**ervice **P**rovider – A company providing Internet access.

ITU **I**nternational **T**elecommunications **U**nion

K

kbps **k**ilo **b**its **p**er **s**econd – 1000 bits/second. A measure of the bit rate or transmission speed of a digital communication link. See also *bps* and *Mbps*.

Ku-band A frequency band used for satellite communications. For terrestrial earth stations, the receive frequency band is in the range 10.95–12.75 GHz and the transmit frequency band is 13.75–14.5 GHz. See also *C-band* and *L-band*.

L

L-band A frequency band commonly used as an IF for satellite systems using block up/down conversion. Typically 950–1450 MHz Rx, 1250–1750 MHz Tx. See also *C-band* and *Ku-band*.

LAN **L**ocal **A**rea **N**etwork

LLA **L**ow **L**atency **A**pplication

LNA **L**ow **N**oise **A**mplifier – An amplifier with very low noise temperature used as the first amplifier in the receive chain of a satellite system.

LNB **L**ow **N**oise **B**lock – A downconverter so called because it converts a whole band or "block" of frequencies to a lower band. The LNB (similar to an LNA) is part of the satellite ODU/transceiver.

LNC **L**ow **N**oise **C**onverter – A combined low noise amplifier and block downconverter, typically with an L-band IF.

LO **L**ocal **O**scillator – A component used in upconverters, downconverters, and transponders for frequency translation (heterodyne) of the carrier signal.

M

M&C **M**onitor **&** **C**ontrol

MAC **M**edia **A**ccess **C**ontrol – A protocol controlling access to the physical layer of an Ethernet network.

Mbps **M**ega **b**its **p**er **s**econd – 1 Million bits/second. A measure of the bit rate or transmission speed of a digital communication link. See also *bps* and *kbps*.

MIB **M**anaged **I**nformation **B**ase – A database used for managing the entities in a communications network. Typically associated with Simple Network Management Protocol (SNMP).

MIR **M**inimum **I**nformation **R**ate – A minimum level of service available to a remote terminal, ensuring the ability to enter a clear channel SCPC circuit or have a timelot in STDMA.

Modem **Mod**ulator and **dem**odulator units combined.

Multicast Transmitting a single message simultaneously to multiple destinations (group) on the IP network.

Multi-command A command that allows multiple input choices in a single command execution.

N

NAT **N**etwork **A**ddress **T**ranslation – An Internet standard that enables a LAN to use one set of IP addresses for internal (private) traffic and a second set of addresses for external (public) traffic.

NBI **N**orth**b**ound **I**nterface – The SNMP interface offered by the VMS to extend services to an external network management system (NMS).

NIC **N**etwork **I**nterface **C**ontroller – The network interface for a PC/workstation that provides Ethernet connectivity. Depending on the computer, the NIC can either be built into the motherboard, or be an expansion card. Some computers (e.g., servers) have multiple NICs, each indentified by a unique IP address.

NMS **N**etwork **M**anagement **S**ystem

NOC **N**etwork **O**perations **C**enter – The main control center for network operations. A NOC can interrogate, control, and log network activities for the satellite Hub as well as any Remote node.

NP **N**etwork **P**rocessor – Also referred to as the IP Module. An optional assembly for Comtech EF Data modems that provides the 10/100 BaseT Ethernet interface that is required when used in Vipersat networks.

O

ODU **O**ut**d**oor **U**nit – In a VSAT system, the RF components (transceiver) are usually installed outdoors on the antenna structure itself and are thus referred to as an ODU. The ODU typically includes the BUC and LNB, and is connected to the IDU/modem by the IFL cabling.

OQPSK **O**ffset **Q**uadrature **P**hase **S**hift **K**eying – A variant of phase-shift keying using four different values of the phase to transmit. Offsetting the bit timing limits the phase shift and yields lower amplitude fluctuations as compared to QPSK, and is sometimes preferred for communications systems. See also *QPSK* and *BPSK*.

OSPF **O**pen **S**hortest **P**ath **F**irst – An open standard interior gateway routing protocol used to determine the best route for delivering the packets within an IP network. OSPF routers use the *Shortest Path First* link state algorithm to calculate the shortest path to each node in the network. The Vipersat OSPF feature in the Comtech SLM-5650A modem/router provides for dynamic routing functionality.

P

PIR **P**eak **I**nformation **R**ate – The bandwidth available for use by any remote terminal on best effort basis, categorized through multilevel prioritization.

PLDM **P**ath **L**oss **D**ata **M**essage – A packet message that is sent by older Vipersat modems (e.g., CDM-570/L) to the VMS every sixty seconds, providing status update and operating parameter information.

PSK **P**hase **S**hift **K**eying – A digital modulation scheme that conveys data by changing the phase of a base reference signal, the carrier wave. Different PSKs are used, depending on the data rate required and the signal integrity. Examples are binary phase-shift keying (BPSK or 2-PSK) which uses two phases, and quadrature phase-shift keying (QPSK or 4-PSK) which uses four phases.

PSTN **P**ublic **S**witched **T**elephone **N**etwork – The world's public circuit-switched telephone network, digital and analog, and includes mobile as well as land-line voice and data communications.

PUM **P**eriodic **U**pdate **M**essage – A packet message that is sent by newer Vipersat modems (e.g., CDM-840) to the VMS every sixty seconds, providing either registration request or status update and operating parameter information (SUM).

Q

QAM **Q**uadrature **A**mplitude **M**odulation – A digital modulation technique in which the amplitude of two carrier waves is changed to represent the data signal. These two waves are 90 degrees out of phase with each other.

QoS **Q**uality **o**f **S**ervice

QPSK **Q**uadrature **P**hase **S**hift **K**eying – Sometimes referred to as 4-PSK, or 4-QAM. A modulation technique in which the carrier is phase shifted +/-90 or +/-180 degrees. With four phases, this modulation can encode two bits per symbol—twice the rate of BPSK. However, it also uses twice the power. See also *OQPSK* and *BPSK*.

R

Remote Satellite earth site that links to a central network site (Hub).

Return Path Transmission path from a Remote site to the Hub site.

RF **R**adio **F**requency – A generic term for signals at frequencies above those used for baseband or IF.

RFC **R**equest **F**or **C**omment – The official publication channel for Internet standards (such as communication protocols) issued by the Internet Engineering Task Force (IETF).

RIP **R**outing **I**nformation **P**rotocol

ROSS **R**oaming **O**ceanic **S**atellite **S**erver – A satellite mobility controller that is a key component in the CEFD SOTM technology solution for marine vessels. Provides for transition of link communications between roaming remote terminal and satellite or Hub with minimal service interruption.

RS-232 A common electrical/physical standard issued by the IEEE used for point to point serial communications up to approximately 115 kb/s.

RTP **R**eal-time **T**ransport **P**rotocol – A standardized packet format for delivering real-time applications such as audio and video over the Internet. Frequently used in streaming media systems, videoconferencing, and VoIP.

Rx **R**eceive

S

SCPC **S**ingle **C**hannel **P**er **C**arrier – A satellite communications technique where an individual channel is transmitted to the designated carrier frequency. Some applications use SCPC instead of burst transmissions because they require guaranteed, unrestricted bandwidth.

SIP **S**ession **I**nitiation **P**rotocol – A general purpose protocol for multimedia communications, commonly used for voice over IP (VoIP) signaling. An alternative to the H.323 protocol.

SLM **S**atellite **L**ink **M**odem (CEFD model designator; e.g., SLM-5650A)

SNG **S**atellite **N**ews **G**athering – A satellite uplink van/truck with television crew on location conducting a live report for a newscast.

SNMP **S**imple **N**etwork **M**anagement **P**rotocol – A protocol defining how devices from different vendors may be managed using a common network management system.

SOTM **S**atCom-**O**n-**T**he-**M**ove – The ability of a mobile remote terminal to roam across satellite beams to preserve link integrity and to automatically connect from one satellite and/or hub to another in a global network.

Star Topology A network topology which, if drawn as a logical representation, resembles a star with a hub at the center.

STDMA **S**elective **T**ime **D**ivision **M**ultiple **A**ccess – A multiple access technique where users time-share access to a common channel with variable-sized time slots allocated on usage.

Streamload Protocol A proprietary Vipersat data streaming protocol.

SUM **S**tatus **U**pdate **M**essage – A packet message that is sent by newer Vipersat modems (e.g., SLM-5650A) to the VMS every sixty seconds, providing status update and operating parameter information.

T

TAP **T**ransmission **A**nnouncement **P**rotocol – A proprietary multicast message sent out by the HCC to all associated Remotes in the group, specifying the relative start time and duration for each terminal to transmit while in Entry Channel mode (ECMv2).

TCP/IP **T**ransmission **C**ontrol **P**rotocol / **I**nternet **P**rotocol – A standard for networking over unreliable transmission paths. See also *UDP*.

TDM **T**ime **D**ivision **M**ultiplexing – A method of multiplexing that provides the transmission of two or more signals on the same communication path or channel, but at different times by utilizing recurrent timeslots.

TDMA **T**ime **D**ivision **M**ultiple **A**ccess – A multiple access technique where users contend for access to a common channel on a time-shared basis. See also *FDMA* and *STDMA*.

TFTP **T**rivial **F**ile **T**ransfer **P**rotocol – A simple file transfer protocol used over reliable transmission paths. See also *FTP*.

ToS **T**ype **o**f **S**ervice

Tx **T**ransmit

U

UDP **U**ser **D**atagram **P**rotocol – A standard for networking over reliable transmission paths.

UDP Multicast A multicast transmission using the UDP protocol.

Unicast Transmitting information/data packets to a single destination on the IP network.

V

VCM **V**ariable **C**oding and **M**odulation – A technique that optimizes bandwidth utilization in a wireless data link by varying the forward error correction code rate and the modulation order within a single carrier. A feature of DVB-S2 that is supported in CEFD modems such as the CDM-800 Gateway Router.

VCS **V**ipersat **C**ircuit **S**cheduler – The ArrangeLink VCS is a proprietary satellite communication scheduling system used to schedule Vipersat network resources in support of a variety of high-priority applications such as video conferencing and scheduled broadcasting.

VersaFEC Advanced forward error correction technology from CEFD that provides maximum coding gain with lowest possible latency to support latency-sensitive data applications, such as voice, video, and cellular backhaul.

VESP **V**ipersat **E**xternal **S**witching **P**rotocol – A switch-request protocol that allows external VPN equipment and Real-time proprietary applications to negotiate bandwidth requests between any two subnets on a Vipersat network. VESP is used by newer Vipersat modems (e.g., SLM-5650A) to send a switch request to the VMS to establish a new satellite link or adjust bandwidth for an existing link.

VFS **V**ipersat **F**ile **S**treamer – A file transfer application utilizing UDP and a proprietary Streamload protocol to transmit data across the Vipersat network.

ViperView The graphical user interface for the client component of the VMS that provides the means to configure, control, and monitor Vipersat satellite networks.

VLoad **V**ipersat **Load** Utility – A comprehensive tool for managing and distributing application, configuration, and identification information for the modem/routers in Vipersat satellite networks.

VMS **V**ipersat **M**anagement **S**ystem – A comprehensive M&C tool providing rapid and responsive control of Vipersat satellite networks. Comprised of client and server components.

VNO **V**irtual **N**etwork **O**perator – A provider of management services that does not own the telecommunication infrastructure. The Comtech Vipersat Network Products' VNO solution allows satellite space segment operators to selectively expose resources in their satellite network to other service providers, customers, or partners.

VoIP **V**oice **o**ver **IP –** The routing of voice communications over the Internet or through any IP-based network.

VOS **V**ipersat **O**bject **S**ervice – The main software service of the VMS application.

W

Wizard A specialized program which performs a specific function, such as installing an application.

WRED **W**eighted **R**andom **E**arly **D**etection – A queue management algorithm with congestion avoidance capabilities and packet classification (QoS) providing prioritization.

{ *This Page is Intentionally Blank* }